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ABSTRACT

This book is intended to offer the teacher practical classroom ideas. The first chapter suggests two approaches in teaching children to inquire and compares the three modes of teaching--didactic, Socratic, and inquiry. The second chapter considers the problem of what people do as they inquire and the relationship between data and theory, which are the products of inquiry. Methods of organizing and using data and of validating theory are discussed. Internal and external constraints are listed, as well as the role of individual values as a counterbalance to these constraints. The third chapter contains some illustrative problems suitable for classroom inquiry and covers the following types of problem: questions, unknowns, conflicts, discrepancies, decisions to be made, incongruities, inconsistencies, ideas to be created, "I don't understand's," and techniques to be mastered or designed. Teacher behaviors are discussed as are various ways of interacting with students to facilitate their growth as inquirees. The fourth chapter deals with the importance of objectives and provides a number of examples for teachers and students. There are two appendixes, the first consisting of a brief sketch of an inquiry lesson which was part of a unit in science and the second describing a 30-hour program designed to reach rather specific objectives in helping teachers develop skills in teaching toward inquiry. (MBM)

Teaching Toward Inquiry

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Foreword

Instructional improvement ultimately depends upon the teacher in the classroom.

Too often in the past, each teacher had to develop his own new methods and ideas. For most, experience gradually tempered the theories acquired in college. Unfortunately, improvement usually came through trial and error.

Today the teacher does not have to work alone. The collective action of the organized teaching profession is being brought to bear on the problems in instruction. Teachers now have the opportunity to share their ideas and experiences with their colleagues throughout the nation. They can work to make their ideas a reality in their own school system and to bring them to the attention of teachers in other parts of the country.

SCHOOLS FOR THE 70's represents an effort by the profession on the national level to bring new ideas to the attention of all teachers—ideas based on practical classroom experience.

Teaching Toward Inquiry is an unusual book. It is designed to be different. Read it carefully. Think about the ideas. It is written solely for your use and for the benefit of your students. It is hoped that the ideas offered are practical. By using these ideas in the classroom you will determine whether that hope is achieved.

Engage in your own pursuit of inquiry as you attempt to improve and enrich your teaching techniques. This book should be a valuable resource as you do.

Donald E. Morrison
President
National Education Association
September 1971

Inquiry is a rational way people solve problems when an answer is not available, or when available answers are not suitable.

To inquire

is to direct one's moment-to-moment thoughts and actions in a way which, to the best of one's present knowledge and belief, will lead to an increased understanding of the problem and eventually to its solution.

Historically, when building the curriculum, planning teaching strategies, or working with students, teachers have sought an answer to the question,

How can I get students to think about content?

When the goals we hold for instruction also include inquiry, a slightly different concern emerges. "How can I get students to think about content?" becomes

How can I use content to get students to think?

That is . . . to think about productive strategies they use as they attempt to solve different kinds of problems.

Teaching toward inquiry is intended to help students—

Learn about themselves, their environment, and others in it.

Expand their repertoire of productive ways of working on problems they encounter.

Develop their ability to deal productively with frustrations that arise as they inquire.

A New Tool for a New Task

The principal goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done—men who are creative, inventive discoverers. The second goal of education is to form minds which can be critical, can verify, and not accept everything they are offered.

J. Piaget

It has been difficult for those of us who teach to understand the instructional implications of the shift from our old question, "What is there to learn?" to a different one, "What is most important to learn?" There is general consensus on which broad areas of knowledge, attitudes, and skills are most important. What is difficult to find is agreement about the *relative* importance of various curricular topics.

The importance of any particle of knowledge is in the eye of the beholder.

As our fund of knowledge continues to grow, so do the intensity of schooling and the time required to meet new demands. When time prevents keeping up with new knowledge, specialization tends to increase. For a while specialization seemed to solve the problem, but information has accumulated more rapidly than we are able to handle it. Now the tendency is to develop new techniques for transmitting knowledge. But these, too, seem to have no lasting effect on our ability to *benefit* from the knowledge explosion.

One consequence of encountering a new task is the attempt to perform that new task by adapting old tools.

A second aspect of the knowledge explosion involves the characteristics of the knowledge.

The number of generic operations that can be performed on knowledge is finite.

There is a limited number of ways in which data can be acted upon. They can be, for example—

1. Recorded.
2. Stored.
3. Processed.
4. Retrieved.
5. Evaluated.

It is important to note that much of what goes on in schools has traditionally focused on operations 1 through 4. That is, students have been taught to record information, store it, process it in some way, and retrieve it as necessary. Math is a good example. Students are taught to count (generate data), write numerals (record and store), add a series of numbers (process), and report the results (retrieve). The tasks students have traditionally been assigned have required these functions. We can envision rows of accountants performing predetermined operations on a given set of numerals.

But technology has intervened: few of these operations remain the sole domain of the human. An increasing number are performed by machines. A computer can—

1. Store information.
2. Process it (transform it as instructed).
3. Retrieve information on demand.
4. Record it in some symbolic form.

Many of the requirements of education in the past are of less significance today, as technology has provided electromechanical devices that perform these functions efficiently and effectively.

Technology frees man to use his unique capabilities for decision making. The decision-making process includes asking the following questions:

1. What is the problem to be solved?
2. What information do I need?
3. In what ways should the data be processed?
4. How valid are the results?

These decisions require a different focus in education, *but not to the exclusion of other tasks.* The demand for the development of basic skills continues to exist. But a new demand has been added. A new tool is needed.

Inquiry focuses on decision making.

Different goals for education (e.g., the development of basic skills and decision-making abilities) require that the students do different kinds of things in the classroom. Different goals for education require different modes of learning.

And different modes of learning necessitate different modes of teaching.

Three Modes of Teaching

1

Lecturing or didactic teaching is a telling, assignment-giving, describing technique. This mode of teaching is functional in passing on information.

The teacher decides what should be presented to the class and how it will be presented.

Didactic teaching is intended to provide input. It is one way of communicating information from the teacher to the student. The teacher selects the material to be presented and encourages the student to attend to it. The student's role in didactic teaching usually involves receiving and storing the input. Evaluation is based on the student's ability to retrieve information from his storage *without acting on that information to transform it in any way.*

2

Socratic teaching is essentially a question-asking technique. It is one kind of programed learning. Certain valued ends are best achieved with this mode of teaching.

The teacher decides what questions to ask of his students.

Like didactic teaching, ***Socratic teaching*** is intended to provide input. The teacher selects the material to be presented and encourages the student to attend to it. In this mode of teaching, however, the teacher's questions lead the student through additional kinds of intellectual operations: storing, processing, and output. Learning to "do" these operations himself is a bonus by-product for the student. Evaluation is based on the student's ability to recall information which has been *somewhat transformed as a result of his and the teacher's intellectual efforts.*

3

Inquiry teaching is directed toward the development of students who are more autonomous in initiating and directing their own learning. A transfer of learning occurs, assisting children in solving problems they meet in the real world.

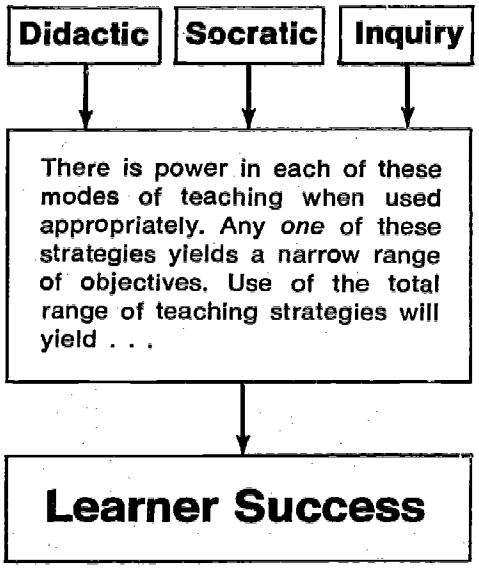
The teacher's role is complex. He must analyze the student's present level of development and employ behaviors that will facilitate the student's growth from that point forward.

In ***teaching toward inquiry,*** the teacher intends that the student learn how to decide what input he needs, what he should store, how it should be stored, and when and what kinds of processing should be done on what kinds of data or ideas. In other words, *teaching toward inquiry is intended to help a student learn how and when to use the range of intellectual processes.* In this mode of teaching, the student finds his own way through these processes. The instructional goal is clearly one of process learning: the development of students who are more autonomous learners. Evaluation is based on the student's ability to apply these processes to the next problem.

Didactic teaching is not the only way to teach.

Socratic teaching is not the only way to teach.

Nor is teaching toward inquiry the only way to teach.



Teaching Toward Inquiry: Two Approaches

Within the inquiry mode of teaching, two approaches have evolved. We'll call them "practicing the skills of inquiry" and the "inquiry approach."

Practicing the Skills of Inquiry

What does practicing the skills of inquiry look like in the classroom? The emphasis of instruction is on developing the students' abilities to "do" the various processes of inquiry. The teacher must develop his own knowledge of the range of processes to be "taught," must gather information about the students' present abilities to "do" such processes, and must plan a series of lessons designed to provide continuing opportunities for the students to practice the selected processes at increasing levels of complexity. The approach centers on getting the students to practice these skills, ideally in different content areas.

If, for example, *observing* has been identified as a process to be practiced, the teacher begins by giving the students something to observe, such as a picture of a town, an aquarium, a group of people, or an art reproduction. Each student then reports his observations. As the students listen to the reports of their peers, each finds observations reported which never occurred to him. Over a period of several lessons, through observing, reporting their observations, and listening to the reports of others, the students increase both the number and the range of their observations.

Other processes are "taught" in much the same way. The teacher identifies a process to be practiced, and the students practice it. During their school years, the students practice the whole range of processes of inquiry, and they get better at them, at least within the context of a skills approach lesson situation. It is expected that they will also do better when it comes to using these processes in working on problems.

An Inquiry Approach

What does an inquiry approach look like in the classroom? Work begins with the identification of a problem by the teacher and/or the students. In responding to the problem, the students usually work in many ways similar to those of the scholar. That is, they theorize, generate data, organize data, and draw inferences from data as they work, probably because using these processes is the way people just naturally respond to problems. Of course the processes the students use in their first attempts are in no way as sophisticated as those of the scholar, and the students recognize this. Their sophistication grows as they become aware of the power of these processes in solving problems. Thus, the inquiry approach centers on solving problems through whatever inquiry processes are relevant to the problem, the inquirer, and the situation.

The student, in addition to sharpening his ability to design and use the processes of inquiry, gains in other kinds of learnings unique to this teaching approach. For example, in learning to inquire an individual must be able to decide—for himself—what inquiry process he will use, and what he will do with it. Afterwards he considers how well the process he used did what he wanted done. In the skills approach, in contrast, the teacher makes these decisions for the students.

The inquiry approach is founded on the notion that there is nothing mystical or special about the ways a scholar works as he inquires. He works in those ways in part because of what he knows, in part because of the specific problem confronting him at the time, and in part because of the ways people just naturally think. The teaching approach that evolves from this as-

sumption, therefore, does not try to "educate" students to "behave like scholars." Rather, it puts students in a situation where they use what they know and are allowed to do what makes most sense to them as they work.

Which Approach To Use?

Our discussion of these two approaches to teaching toward inquiry is not intended to suggest that teachers be limited to one or the other. Each has unique values and limitations. Both should be a vital part of all educational programs in all content areas. The teacher should decide which of these approaches to use at any moment in the classroom on the basis of the specific objectives sought at the time. If the development of a specific process ability is the primary objective of instruction, then a skills approach should probably be used. If, on the other hand, the objective is the continuing development of the students' repertoire of problem-solving strategies, an inquiry approach is probably called for.

Now,

If you'd like to know more about th
way people behave as they inquire, g
on to the section titled "What D
People Do As They Inquire?" (p. 17)

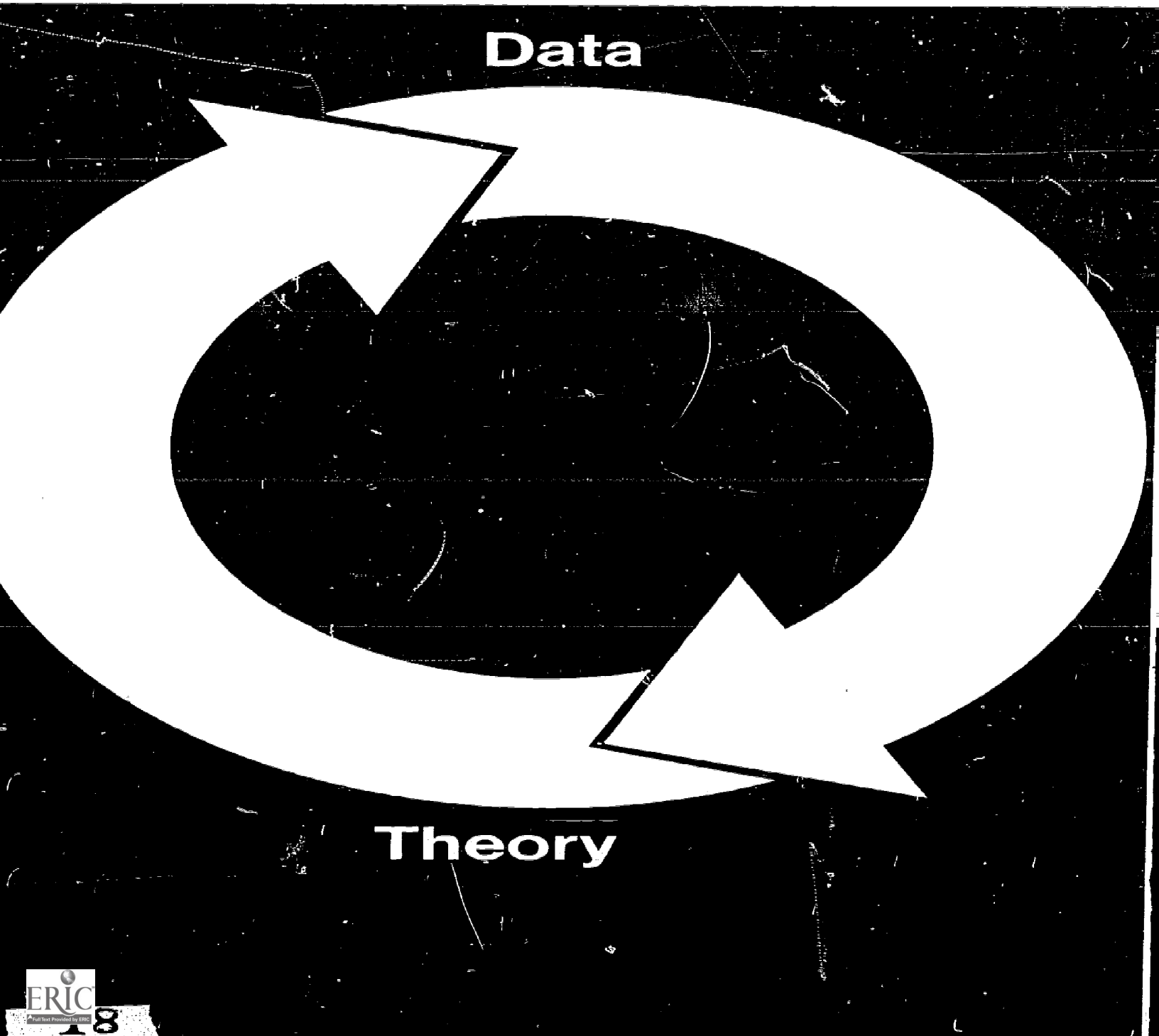
If you'd prefer illustrations of specif
teacher behaviors, see "Facilitatir
Inquiry in the Classroom." (p. 41)

If you're interested in examples
process objectives for students i
creasing their power as inquirers ar
for teachers perfecting their skills
teaching toward inquiry, go directly t
"Objectives in Inquiry." (p. 67)

If you'd like to see a transcript of a
inquiry lesson, turn to Appendix I. (
79)

If you're interested in an in-servic
series in teaching toward inquiry, tu
to Appendix II. (p. 87)

Or, just turn to the next page . . .


Data
Theory

Consider first the PRODUCTS of inquiry.

DATA:

Descriptive statements about—

OBJECTS
SYSTEMS OF OBJECTS
CONDITIONS
EVENTS
PEOPLE
PLACES
FEELINGS

Including—

People

What they believe—what they value.

How they behave—what they do.

What they make and their reasons.

How they use things.

How they look to themselves and others.

How they feel about themselves and others.

What problems they have—what they are worried about.

Where they live—what they eat.

What they think.

What they say and how they say it.

and Things

Quantification of objects, elements of objects, or conditions of objects.

Events that involve some change in objects or conditions of objects.

THEORY:

An inference about relationships among—

OBJECTS
SYSTEMS OF OBJECTS
CONDITIONS
EVENTS
PEOPLE
PLACES
FEELINGS

Including—

People

What they believe—what they value.

How they behave—what they do.

What they make and their reasons.

How they use things.

How they look to themselves and others.

How they feel about themselves and others.

What problems they have—what they are worried about.

Where they live—what they eat.

What they think.

What they say and how they say it.

and Things

Quantification of objects, elements of objects, or conditions of objects.

Events that involve some change in objects or conditions of objects.

These are but different abstractions of the same reality.

DATA: *Descriptions* of selected parts of that "reality"

THEORY: An *explanation* of that "reality"

DATA—

Are a base from which *theories* evolve.

Are the "reality base" against which *theories* are tested.

Create the necessity for *theory*.

In part, whether—

Data are "good" or not depends on the means by which they were produced.

Data are useful or not depends on the theory being tested at the time.

THEORY—

Is a base from which decisions about the *data* to be sought are made.

Is a base from which predictions about *data* are made.

Creates the necessity for *data*.

In part, whether—

A *theory* is "good" or not depends on the data that are consistent or inconsistent with it.

A *theory* is "powerful" or not depends on the data it serves to explain or predict.

A dynamic relationship exists between these PRODUCTS of inquiry.

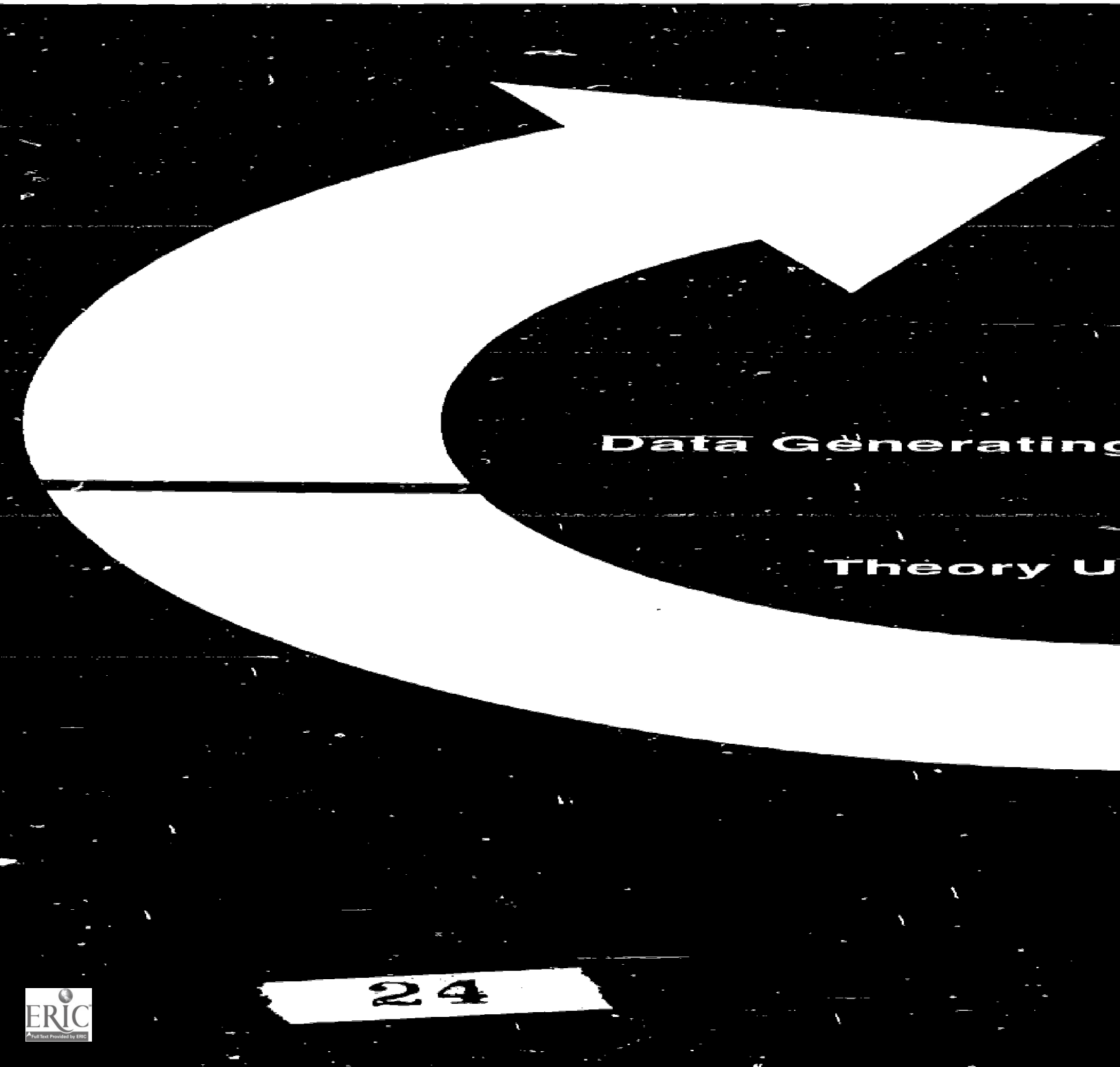
In moving from THEORY to DATA two groups of PROCESSES are—

Theory Using

Means doing such things as—hypothesizing, predicting, modeling, identifying assumptions inherent in a theory, interpolating, extrapolating . . .

Data Generating

Means doing such things as—observing, counting, interviewing, voting, measuring, experimenting, using books, films, and other secondary data sources . . .


Data Generating
Theory U

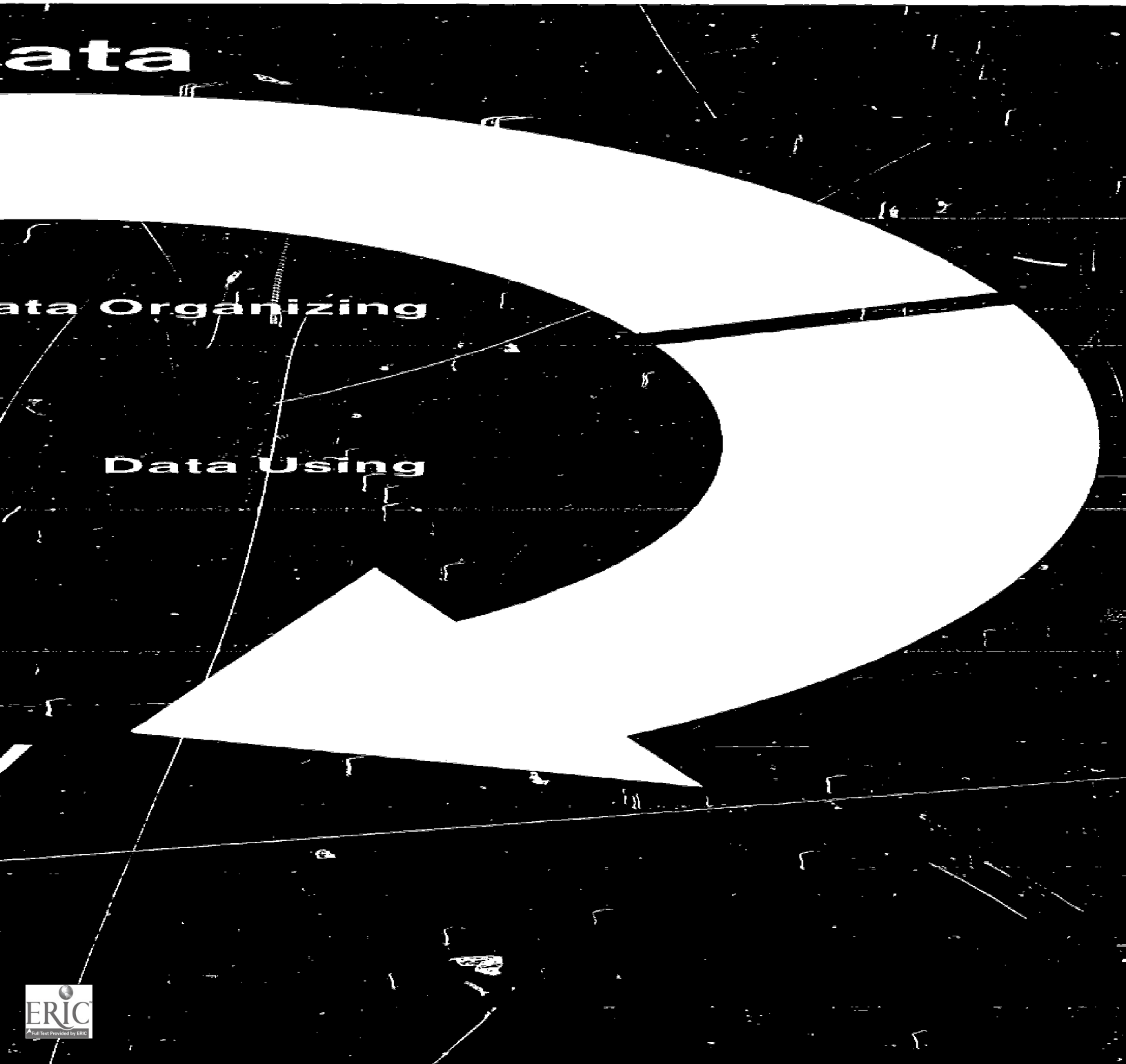
In moving from DATA to THEORY two groups of PROCESSES are—

Data Organizing

Means doing such things as—
writing, listing, drawing, taking pictures, graphing, charting, using various recording instruments, classifying, computing, collating, synthesizing, enumerating, labeling . . .

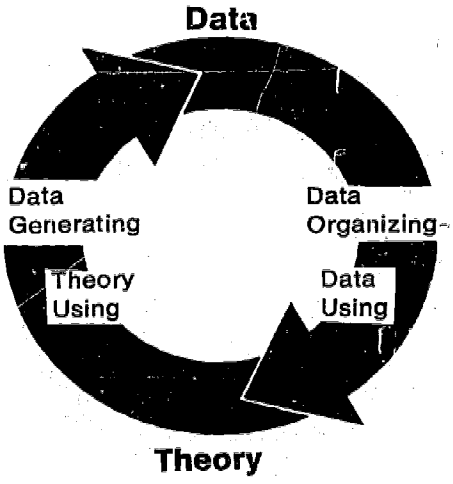
Data Using

Means doing such things as—
explaining, concluding, making analogies, generalizing, inferring, abstracting, theorizing . . .


ata
ata Organizing
Data Using

The "Inside Loops"

So far, the model of inquiry we have been building looks like this:

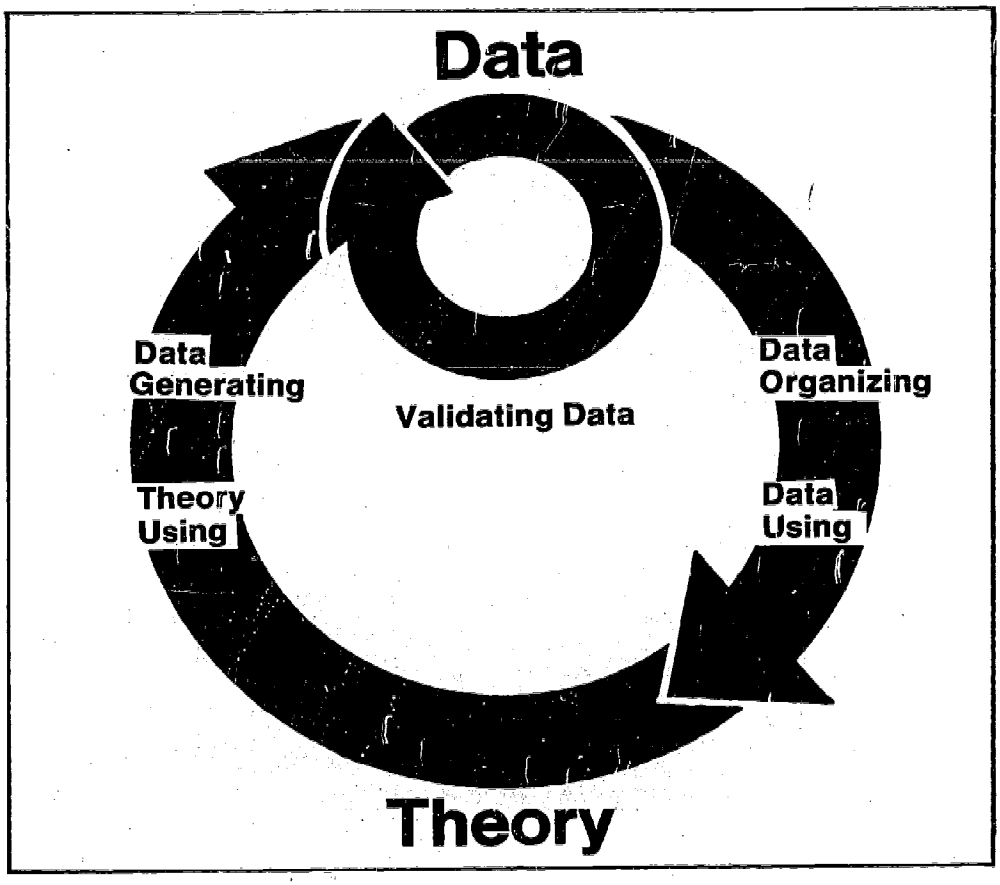


It describes the behavior of an individual as he moves about the data-theory loop—as he gets an idea in relation to a problem situation and then subjects it to the test.

Inside Loop Number One

When an inquirer generates data, he usually wants to make certain the data he gets are valid. To do so he may repeat the data-generating process, use a different data-generating process designed to yield the same data, or ask someone else to generate the same data. Attempts to make certain that the data are valid can be represented on the model by the "inside loop number one."

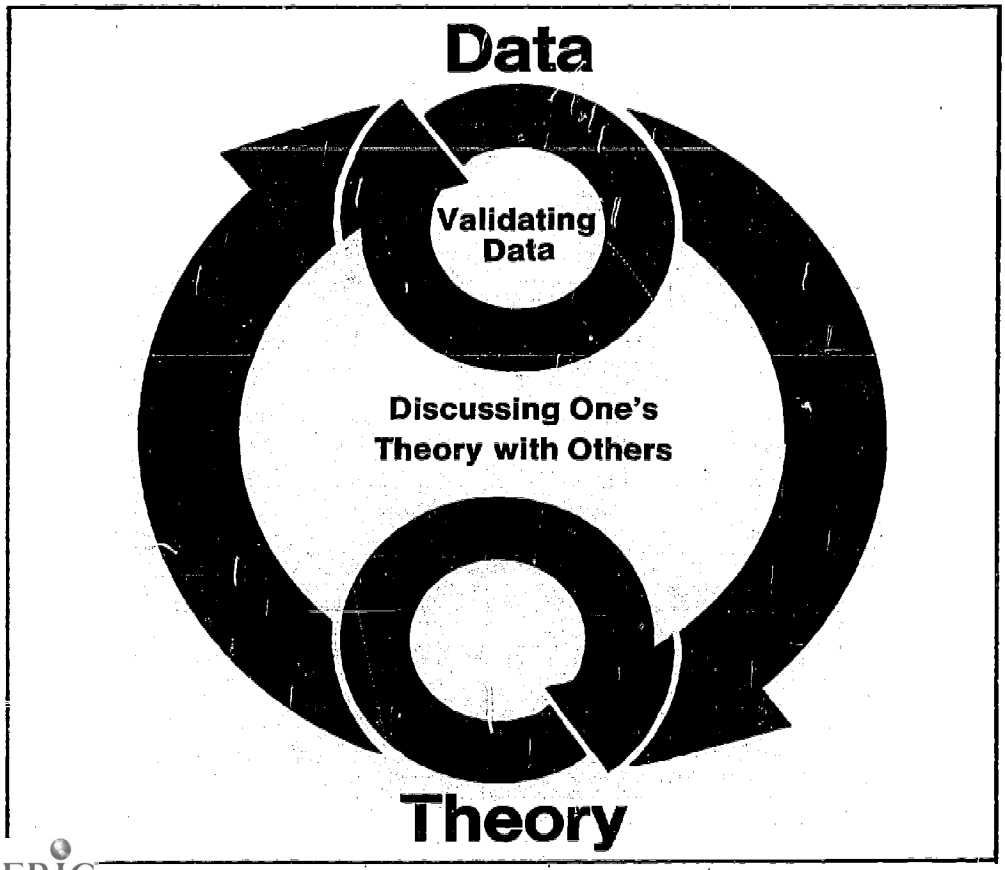
It must be noted, however, that there are times when two sets of data conflict, and when presently available means of validating data yield inconclusive results. This very conflict in data may provide *a new problem* for one's inquiry.



Inside Loop Number Two

When a person inquires, he talks to other people about his theories. He may invite them to respond to the problem as well. Through this kind of social interaction, the inquirer "taps" the relevant data and theories of others. In addition, the mere act of talking about his ideas helps clarify them and frequently yields the inquirer greater insight into his theories. Talking to people in this way for these purposes can be represented on the model by the "inside loop number two."

Our model of inquiry now looks like this:



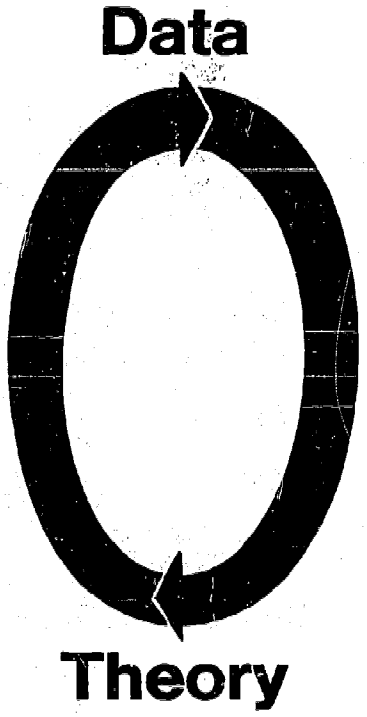
The Time Factor

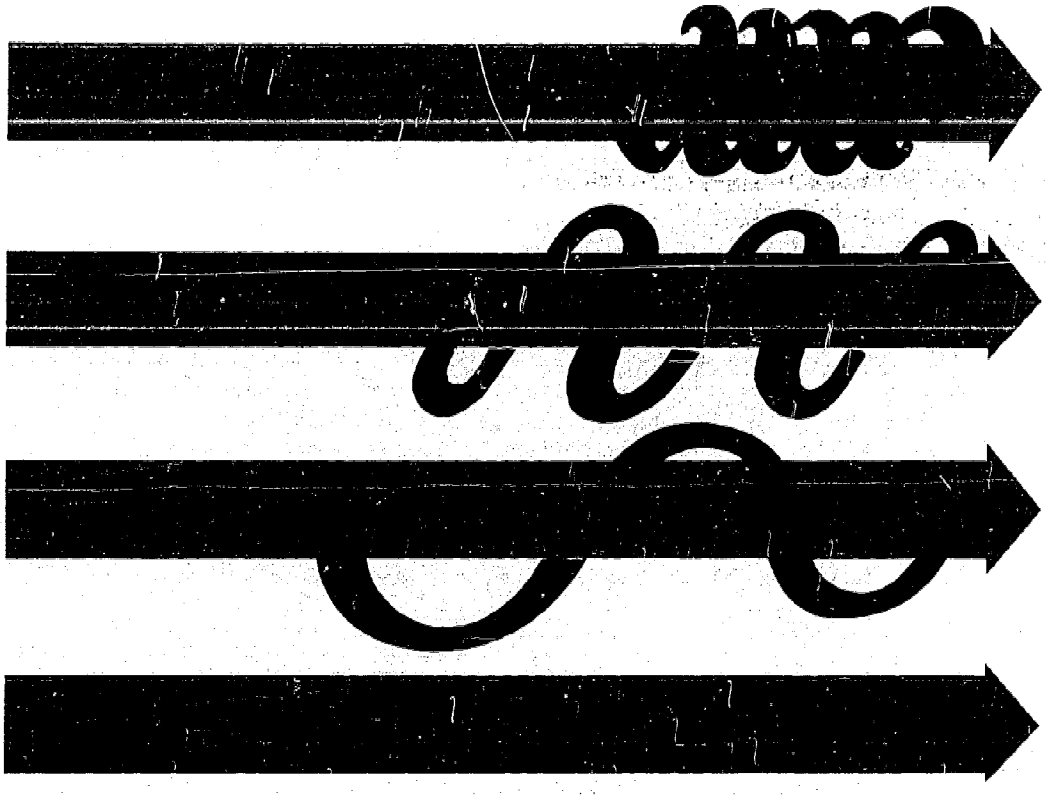
The data–theory loop model of inquiry, as represented in two-dimensional form alone, is inadequate. It looks as though working from theory to data to theory, etc., takes one's inquiry back to where it started. That's not what really happens.

Once around the data–theory loop, and the theory may have some data substantiation it did not have before. Or, if the data did not "fit," the theory may be in need of rethinking or modification. **In any case, the theory is no longer the same as it was at the outset.**

To overcome this limitation of the two-dimensional model of inquiry, imagine the data–theory loop as viewed from the side.

As one inquires—gathers data, matches it to theory, gathers data, etc.—the "loop" moves through time.





When data are *readily accessible,* the inquiry that begins with one's first confrontation with a problem and continues through time appears as "tightly wound" loops.

When generating data or searching for an appropriate theory takes longer, fewer data–theory loops occur in the same period of time.

When generating data is a very long process, one data–theory loop takes a long time, and inquiry takes a long time.

When no data are available, no data–theory loops are possible. No inquiry?

Actually, because—

thinking takes time,

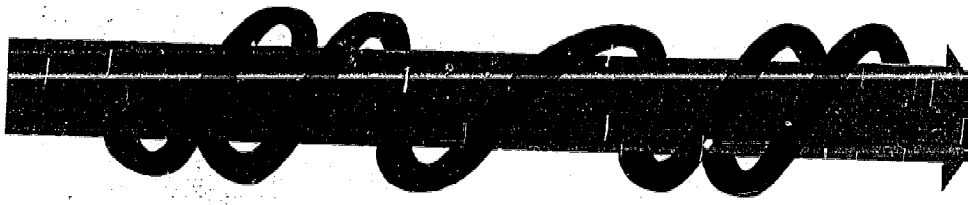
finding an appropriate theory takes time,

there are always other things to do in life besides work on a specific problem, and

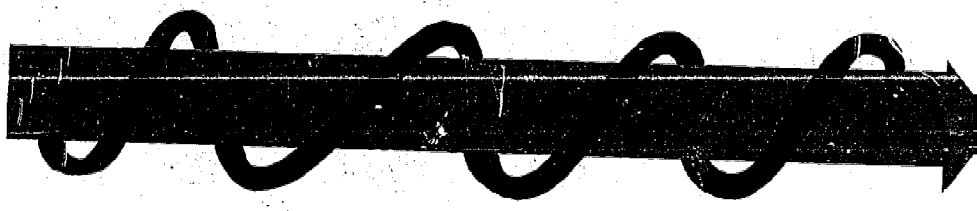
within one problem situation some data are readily available while some take more time to acquire,

inquiry proceeds in "spurts."

"Fast-moving" inquiry really looks something like this:



Slower-moving inquiry looks more like this:



Two Cautions

1

This representation of inquiry is meant to characterize what people do as they inquire. *People don't try to "follow the model"; rather, the model tries to "follow people."* Of the groups of processes identified, each inquirer does next what seems most sensible to him in relation to the problem at hand.

2

It is the intent of the data–theory loop model of inquiry to explicate a *generic* concept of inquiry. Thus, the PRODUCTS and PROCESSES are viewed as they are used in various disciplines.

However, because of the different kinds of problems they explore, inquirers at work in different disciplines—

Use different "stuff" as data.

Ask different questions of their data (have different criteria of acceptability).

Use different data-generating and data-organizing processes because of the different kinds of data they seek.

Also, what is called a "theory" varies somewhat from discipline to discipline. Therefore, while the data–theory loop model outlines the range of processes used in all disciplines, an inquirer would probably use the same generic processes in different ways while working on different problems . . . or use only some of the processes identified in the model of inquiry while working on any one problem.

Constraints and Values

As people use inquiry processes to solve problems, their efforts are influenced by what we call internal and external constraints and individual values.

Internal Constraints

The internal constraints are factors within the inquirer that limit his effectiveness, such as the content he does not know and the processes he is unable to use—at the time. Another internal constraint might be inability to work with others, which would limit the inquirer to working only on those problems suitable for one working alone. However, the internal constraints experienced by an individual change from moment to moment, from problem to problem.

External Constraints

There are two external constraints outside the inquirer that influence his work: the discipline in which he is working, and the society in which he lives. The structure of his discipline affects an individual's inquiry into problems of that discipline through the—

Data he uses, which must be consistent with what others working in the discipline use as data.

Theories he uses, which must meet the functional demands of theories of the discipline. The most common functional demands are to explain, to predict, and to serve as a base for making decisions.

Processes he uses, which must be consistent with the processes others working in the discipline use, and with the problem under exploration.

Problems he explores, which generally are similar to the kinds of problems under study by others working in the discipline at the time.

How much of an effect the structure of the discipline has on an individual's inquiry depends on whether he intends to contribute to that discipline or only to enhance his own understanding.

The society in which the inquirer lives influences inquiry through the kinds of *problems* it deems inquirable. In some instances society places limits on the kinds of *processes* that can be used, as well. For example, experimentation with human lives is prohibited by our society.

Indeed, the very existence of inquiry as a legitimate human activity in a society is a mirror of the values of that society.

Because of these internal and external constraints inquirers are seldom if ever completely autonomous.

Individual Values

While it is difficult if not impossible to define values, it is possible to identify ways in which an inquirer's values influence his inquiry. To inquire is to make choices and to take action. At each step of one's inquiry individual values become apparent through the choices one makes and the action one takes on each choice.

Choosing	Acting
Problems: Of an array of problems suitable for inquiry, an individual chooses one problem in preference to others.	*Problems:* He takes no action on the problem chosen. He takes action but terminates inquiry without a solution. He takes sustained action culminating in a solution to the problem.
Processes: Of a range of processes useful in generating data, organizing data, using data, and using theories, an individual chooses one process in preference to other alternatives.	*Processes:* He fails to use the process selected. He initiates action on the process but doesn't complete it. He initiates action on the process and carries it out to his satisfaction.
Data: Of a set of data an individual identifies as necessary to test a theory, he chooses some data in preference to other data.	*Data:* He fails to generate the data chosen. He generates only a portion of the data chosen. He generates all of the data chosen.
Theories: Of several plausible theories in relation to the problem at hand, the individual chooses certain theories rather than other theories.	*Theories:* He fails to test the theories chosen. He partially tests the theories chosen. He devotes sustained energy to testing the theories chosen.

Individual Values As a Counterbalance to Constraints

While internal and external constraints tend to limit one's inquiry in different ways, an individual's values can offset these influences. For example, an individual is limited by the content he doesn't know and the processes he is unable to use, but his valuing of inquiry as a way of working can provide the long-term commitment of energy that keeps him going while he *gets* the content and *learns to use* the processes he needs.

Likewise, the values of a few dedicated and adventurous (and usually unpopular) inquirers within a discipline can work to change that discipline's external constraints. For example, through the efforts of "unconventional" inquirers, the criteria used to judge valid data, useful theories, productive processes, and suitable problems for a particular discipline may gradually be redefined.

Such individual commitment can also slowly reshape societal value systems. As a result of the gradual reshaping of societal barriers by individual inquirers, problems and processes once deemed unsuitable for inquiry can become acceptable. And vice versa.

The data–theory loop is one model of inquiry, one way of thinking about what people do and how they are influenced by the world around them as they attempt to solve problems.

But a model of inquiry is not a model of instruction, nor is it a teaching strategy. The logical next question is,

What does instruction look like that makes inquiry possible in the classroom?

This is the subject of the next section.

If inquiry is to take place, there must be a problem to work on.

Problems people work on may emerge as—

Questions

Unknowns

Conflicts

Discrepancies

Decisions To Be Made

Incongruities

Inconsistencies

Ideas To Be Created

I Don't Understand's

Techniques To Be Mastered or Designed.

A problem need be only as complex as the inquirer makes it.

On the following pages are some illustrative problems suitable for classroom inquiry. While all of them may not be appropriate for your classroom, they may serve to suggest the kinds of problems in your curriculum that would be suitable.

La Paz

If you compare the length of airport runways in different cities of the world with the length of the runway at La Paz, Bolivia, you'll find the La Paz runway longest of all.

Problem Question:

Why is this so?

Ghetto Stores

Why is it that it costs more to shop in a ghetto store than in a similar store outside the ghetto area?

Problem Questions:

Are these data valid?
If so, why is this so?

The Floating Needle

A needle or razor blade can be made to float on the surface of a pan of water. When a drop of liquid detergent is carefully placed into the water, however, the floating razor blade or needle will sink.

Problem Question:

Why is this so?

The Playground

Problem Statement:

Your task, as historians, is to write a chapter in the history of the playground as it occurred at lunch time yesterday. You all were there![1]

[1] Clements, H. Millard, *et al. Social Study: Inquiry in Elementary Classrooms.* Indian- Bobbs-Merrill Co., 1966. pp. 224-28.

Gas Stations

From a study of the community:

Problem Question:

Why are gas stations usually located on corners?

The Sleeper

The Chinese have a story of Wang Chih, who comes upon some elders playing chess in a mountain grotto, falls asleep, and does not return for centuries.

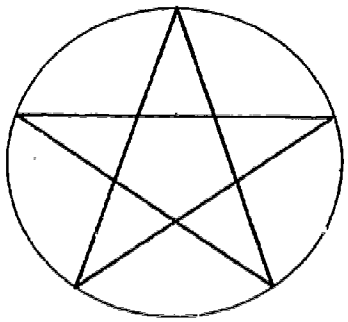
1. In 1496, Erasmus recounted the myth of a Greek named Epimenides who slept for 57 years.
2. Another story has seven early Christians hiding in a mountain to escape persecution by the Romans. They slept for 360 years.
3. The same story, with some alterations, appears in the Mohammedan Koran.
4. The Babylonian Talmud describes how a teacher named Honi the Circle-Drawer fell asleep for 70 years.
5. Washington Irving writes of Rip Van Winkle, who fell asleep for 20 years.

Problem Question:

Why is it that this notion of man's sleeping for long periods has such a hold on the human imagination? [2]

[2] Based on a hypothesis proposed in another book in the SCHOOLS FOR THE 70's Series. *See* Sand, Ole. *On Staying Awake: Talks with Teachers*. Washington, National Education Association, 1970. 10-11.

Points, Lines, and Areas



Locate some points on the circumference of a circle. Connect all points by all possible straight lines. Add a point. Connect it to all other points. Here are the data we've generated so far.

Pts.	Lines	Areas
1	0	1
2	1	2
3	3	4
4	6	8
5	10	14
6		
7		

Problem Question:

Observe the number patterns for points, lines, and areas:

Points	1	2	3	4	5
Lines	0 (+1)	1 (+2)	3 (+3)	6 (+4)	10

But what about the areas? Why the discrepancy? What other discrepancies arise as additional data are generated?

A Way of Thinking About Students' Growth As Inquirers

People solve problems every day of their lives. Kids are people. They solve problems too. Why then are we trying to help our students become problem solvers if they already are?

Inquiry is more efficient if the inquirer knows what he's doing and does it on purpose.

The Process Learning Sequence

Our purpose in teaching toward inquiry is not to help students begin to inquire, but rather to help them get better at inquiring in ways most of them would probably not get better on their own.

One way of thinking about how students become more efficient inquirers is referred to as the process learning sequence. We have found this sequence useful as a base for prescribing teacher behaviors and identifying suitable problem situations. As students inquire, under the influence of a teacher practiced in teaching toward inquiry, each student's theory-seeking and theory-testing processes and strategies evolve through three identifiable stages. With time, experience, and thought, the students' inquiry processes and strategies move. . . .

From the Intuitive Stage

When a student begins work on his first inquiry problem in the classroom, he usually works intuitively. He confronts a problem and does something. He doesn't know what he's going to do as he gets started, nor does he know what he did when he has finished working (problem solved or not). Because he is not aware of the processes he used, those processes are not dependable for him. That is, they are not "there" for him the next time he finds himself in a similar circumstance. Each problem is a new encounter, a new experience. It's like finding your way when you don't know where you are, where you've been, or where you're going. Intuitive inquiry is trial-and-error problem solving.

This trial-and-error quality of the student's work makes us view intuitive inquiry as noncumulative experience in relation to learning the processes and strategies of inquiry. However, even at this stage there is some transfer that does influence both the student's degree of involvement in the next problem and his ways of working. Responding to a problem intuitively is a very useful way to get something done when no strategy is known at the time, or when all known inquiry processes and strategies are exhausted. One's intuitive sense is a continuing source of new ways to work and of new applications of old ways.

The intuitive stage is the threshold to the awareness stage of development.

Through the Awareness Stage

The awareness stage is the beginning of a student's formal conceptualization of the processes and strategies of inquiry. At this stage he is able to identify the various inquiry processes he uses. That is, he is able to talk about *what he did* as he worked on a problem. This capability opens up a new realm of experience and learning for him. It enables him to study what he and others *do* as they attempt to solve problems. Most importantly, a student at the awareness stage is able to experiment systematically with various inquiry processes and strategies to find out what they will do for him.

To the Functional Stage

Becoming a more systematic and productive inquirer involves not only being able to "do" the various inquiry processes and strategies, but also knowing when to use them.

A student at the functional stage begins to consider such issues as (a) What did the process I used do for me? (b) In what situation(s) is it useful? (c) How will I know when to use it the next time?

At the awareness stage, a label is tied to a process the student has used intuitively. At the functional stage, a process is tied to a purpose or function. Thus, the student is able to select a course of action in terms of what he wants to do. And he is able to decide to use that strategy *again* when he finds himself at a similar juncture in his inquiring.

To summarize, in response to a problem situation, the student intuitively uses some action or

Process

After he has used this process on a few occasions, he ties a name or label to it, yielding

A Labeled Process

With a label tied to a specific process, it is possible for the student to put a "handle" on his experiences so he can think about, talk about, and draw on them more effectively in the future. As the student continues to use this process in both new and familiar situations, his understanding of what it will do for him increases. It becomes

A Prescribed Process

At this point the inquiry processes take on power for the student because he gains the ability to prescribe a process or strategy in terms of what he wants to do next.

A crucial prerequisite for teachers teaching toward inquiry is the ability to "read" student behavior in terms of the four kinds of processes identified in our discussion of the data-theory loop model of inquiry in Section II:

Generating Data (e.g., experimenting)

Organizing Data (e.g., charting)

Using Data (e.g., theorizing)

Using Theories (e.g., predicting)

Whether or not a problem situation leads to classroom inquiry is dependent primarily on what the teacher does and does not do. With some students the teacher's major role is nothing more—or less—than to say and do those things that make inquiry possible and legitimate in the classroom. With other students the teacher needs to use certain interventions designed to help them begin to test their ideas. To facilitate the students' growth, the also helps them become aware processes they use as they nd, at certain times with all students, the teacher seeks to generate diagnostic information about their growth as inquirers.

Thus, teaching toward inquiry means the teacher—

Establishes and maintains the classroom conditions for inquiry.[3]

Facilitates the students' growth as inquirers.

Generates diagnostic information about the students.

[3] The concept of the classroom conditions for inquiry is discussed in Suchman, J. Richard. *Developing Inquiry.* Chicago: Science Research Associates, Inc., 1961. pp. 14-18.

Seventeen behaviors through which teachers may implement these three roles have been identified.[4] They are behaviors many people use intuitively (and some by design) as they teach. Therefore, many of the behaviors will probably seem familiar. Our purpose in the following discussion is to make their use more deliberate.

[4] A comprehensive treatment of each of these teacher behaviors may be found in Strasser, Ben B. *Teacher Behaviors in Teaching Toward Inquiry.* Hayward, Calif.: JS² Publishers, 1970.

Teaching toward inquiry is more effective if the teacher knows what he's doing and does it on purpose.

Establishing and Maintaining the Classroom Conditions for Inquiry:

The Conditions Set of Teacher Behaviors

In the descriptions that follow, remember that each behavior may be carried out through *an infinite variety of words and/or actions*. The examples given are only illustrative.

1. Focus Setting

Fundamental to any inquiry is a problem to solve. Problems suitable for classroom inquiry may be identified by the teacher or the students. In those cases where the students identify a problem, the teacher's role is to make that problem a "legitimate" one for classroom inquiry (where the problem suggested is within the bounds of the content of instruction and/or district policies). The teacher behavior through which a problem for inquiry is "established" for the students is called Focus Setting.

"One problem you may want to work on is . . ."

"Ole, you've identified another problem you or other students may want to work on: Why does . . ."

2. Structuring

Any time a group of students—and their teacher—are at work in the classroom, the students must know what is expected of them, what they can expect of their teacher, and how they are to work. The students should know before the lesson starts that it's their responsibility to decide—

What ideas or theories seem appropriate to the problem at hand; what theory-seeking strategies they will use.

How they will test the appropriateness of their theories or ideas; what theory-testing strategies they will use. This involves identifying the data they will need to test out their theories, and designing and implementing the various inquiry processes they will use to generate and organize the data.

Whether their ideas or theories are satisfactory as they are or whether they should be rethought, modified, or discarded.

What is to be done next, including—

Considering the problem solved for now or for good. (How do you know when a problem is solved?)

Stopping work on the problem for now, to come back at it at some later time.

Revising the theory and retesting it.

Searching for a new theory.

The teacher behavior through which the structure for the lesson and for student-teacher and student–student role relationships is communicated to the students is called Structuring.

"Today as we work we're going to be doing some things a bit differently than we have in the past. I'm going to . . . . Your job will be to . . . ."

While working on a problem is essentially an individual matter, each student doing what he feels should be done to solve it, the work takes place *in a social context*. The students state their ideas in the presence of other students, talk to their teacher and to other students about ways of working, and generate data which are also available to other students. The teacher must maintain open lines of communication among the students and between them and himself. He does so by using the Structuring teacher behavior.

"Robert, if you disagree with Ann's theory, that's all right. Each person decides for himself which idea makes the most sense to him. Ann can use her theory, and you can use yours. The main issue is, Does your theory 'fit' the data?"

3. Clarifying

To maintain open lines of communication between the students and himself, the teacher seeks to fully understand what the students are saying when they speak to him. When he doesn't, he may ask a student to repeat or restate his comment. Or he may restate what he thinks the student is saying in an "Is this what you're saying?" context. However, the purpose of this dialogue is to help the teacher understand what the student is saying or what he means, *not to put words in the student's mouth or to "teach him something."* The behavior useful in helping the teacher understand what the student is saying or doing is called Clarifying.

"Don, may I ask you to repeat your theory? I don't think I really understand what you're saying."

"Howardine, are you saying that . . . ?"

4. Accepting

An equally important aspect of open lines of communication is a nonjudgmental, nonvaluing climate in which the students may state their ideas without being condemned, laughed at, or "taught at." The behavior through which the teacher maintains a nonjudgmental, nonvaluing posture is called Accepting.

"I see what you're saying. OK, Chick."

"That's an interesting idea, Jane."

"Un-huh. It could be."

"Oh, I understand. Thanks for sharing your idea with us. Would you like me to put it up on the board with Art's and Chuck's theories?"

5. Responding to Student's Data Probe

If inquiry is taking place in the classroom, the two products of inquiry, data and theories, are in evidence. Theories come from the minds of the students. Data, on the other hand, must be accessible to the students from their environment. The teacher behavior through which the teacher facilitates the students' data-generating processes is called Responding to Student's Data Probe.

Student: "I need to talk to some of the third graders who played in the kickball area to see what they saw out there during lunch time."

Teacher: "OK, Grant. I'll talk to their teacher to see if we can make arrangements for you to talk to some of the students this afternoon. Is that OK?"

T: "Yes, that is freon inside the dunking duck."

S: I want to go down to the school library to check the atlas—or something—to see if I can find out what kinds of trees grow on the east and west sides of the Mississippi River. And I also want to look up steamboats to find out what kind of wood they used.

T: Let's see, the librarian is there now. You may go now if you'd like. Or you can go this afternoon.

T: "Steve, I believe the mayor stated that . . . ."

6. Teacher Silence

It is important to prevent the usual kinds of teacher leading, guiding, and directing, legitimate in other modes of teaching, from getting in the student's way during the inquiry activity. The teacher behavior through which maximum autonomy is provided to the student is called Teacher Silence.

S: . . .

T: . . .

The intended message to the students is that if they are to build and check out their ideas they must initiate their own action to do so.

Teacher Behaviors As Related to Student Inquiry Processes

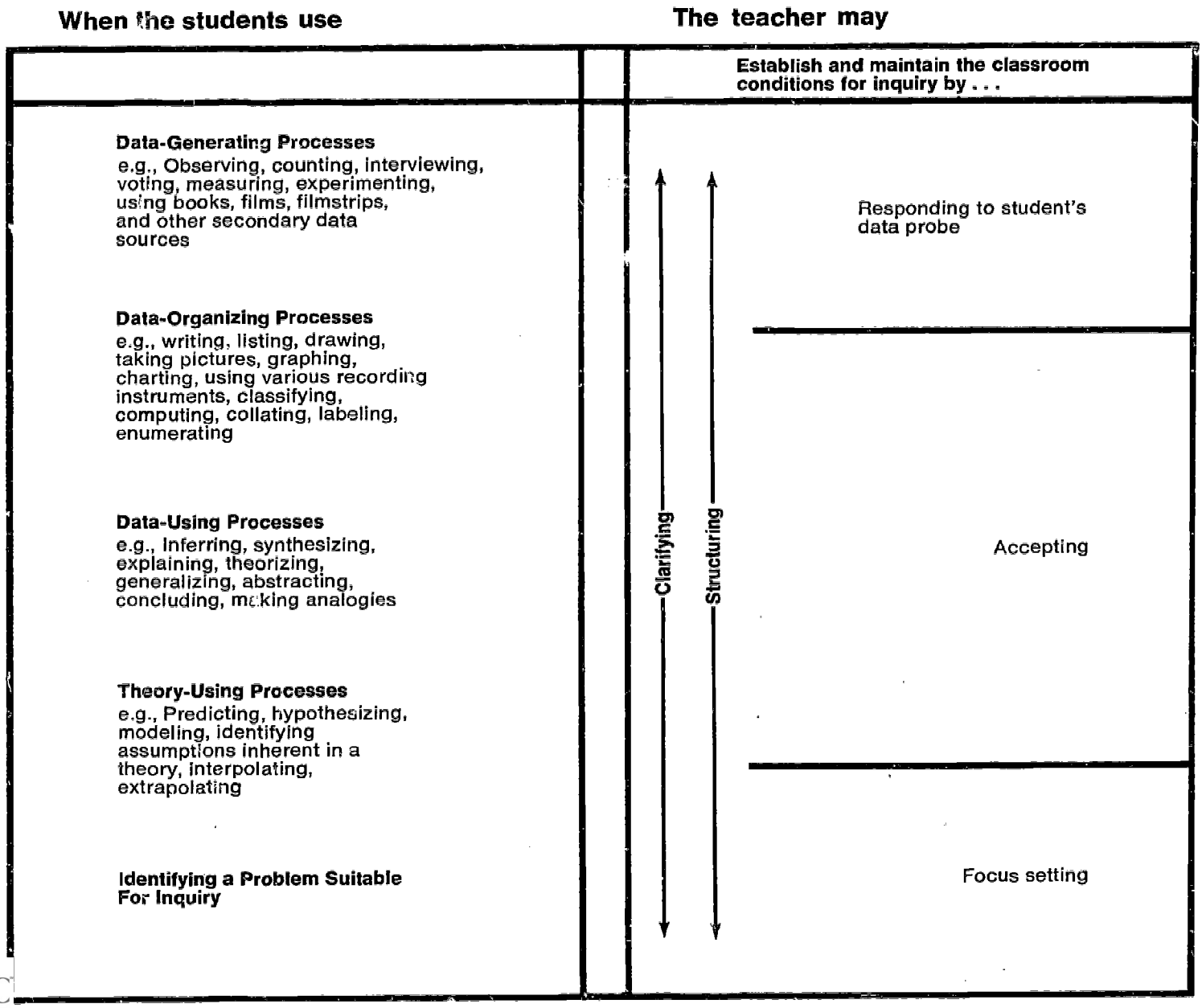
Our major purpose in identifying teacher behaviors in teaching toward inquiry is to *increase the teacher's alternative ways of interacting with his students,* and therefore to extend the range of goals and objectives attainable in his classroom.

The six teacher behaviors discussed so far suggest six different ways of interacting with students, each yielding a different effect. And when combinations of these behaviors are considered, the range of alternatives open to teachers is considerably extended.

The chart that follows relates each of the behaviors in the conditions set to what students do as they inquire. Note that Teacher Silence is not included in this chart. Teacher Silence is, obviously, a behavior related to nonactivity and thus does not relate to the inquirer operations outlined on the chart.

As the other two sets of teacher behaviors are discussed, they too will be added to the chart. Thus, by the conclusion of this discussion the chart will show all the possible ways of interacting with students in teaching toward inquiry.

Alternative Ways of Interacting with Students



Facilitating the Students' Growth As Inquirers:

The Growth Set of Teacher Behaviors

A fundamental dilemma in facilitating the growth of students as inquirers is how to do enough so that they taste success, and yet not so much that the success they feel is their teacher's success rather than theirs.

The first step in facilitating students' growth as inquirers is to make it *possible* for them to inquire: to create the classroom conditions for inquiry. With the conditions created and maintained, many students will take action to solve problems on their own. Several will move from problem to solution by themselves. However, many students will be unable to find their way from problem to solution without help.

Thanks to the newness of the lesson structure and to the effect of the conditions for inquiry, most students will continue to attend to the problem situation over the course of the first inquiry lessons even if they are not successful at solving the problem. However, for students to really "get the feel" of the personal meaning that comes from solving a problem, they must experience moving from problem to solution. To provide the kind of support necessary—matched to the capabilities of the individual students—additional teacher behaviors are required.

The Process Support Sequence of Teacher Behaviors

Several teacher behaviors have been found useful in working with students who are unable to move from theorizing to testing out their theories on their own. These behaviors represent different kinds of help for different students—or different kinds of help for the same student as he progresses through different levels of development.

7. Probe for Data

The teacher invites the student to consider *what data* he needs to test the appropriateness of his theory.

S: My theory is that the larger cities are decreasing in population because they are old and people move away from old, junky places. They stop going to junky stores, too.

T: What data do you need to check that one out, Fritz?

8. Probe for Operations

Many students who need the teacher's help will be unable to respond to the Probe for Data, because it calls for some rather intellectually sophisticated thought. No response by a student means that next time the teacher will want to provide more help. Next time, with that student, the teacher will use a Probe for Operations.

This teacher behavior invites the student to consider *what action* he'll take to test his theory.

S: My theory is that the larger cities are decreasing in population because they are old and people move away from old, junky places. They stop going to junky stores, too.

T: What might you do to test that theory, Fritz?

Most students respond to this teacher behavior by naming some data-generating process they'll use, and take action to get the data they need. But not all students.

9. Suggesting an Operation

An alternative that provides more help for the student is called Suggesting an Operation. The teacher names an inquiry process the student may use to test his theory.

S: My theory is that the larger cities . . .

T: You can test out your theory by verifying that the larger cities we're talking about *are* "junky" places.

With the student who does not respond to either of these last two teacher behaviors, the teacher may decide either to wait longer and let him gain more experience, or to offer him maximum help in testing his idea.

10. Designing Operations

With this behavior the teacher actually designs one or more operations the student may carry out to test his theory.

S: My theory is that the larger cities . . .

T: One thing you can do to find out whether the cities we're talking about are junky places is to go through our data bank to look at pictures of various places in New York, Los Angeles, San Francisco; or you can go through our film and filmstrip catalogue to see if we have. . . .

As soon as a student begins to respond to one of these process support teacher behaviors, the teacher will then move back "up" the alternatives in order to call for more thinking on the part of the student—to demand student growth in the use of theory-testing processes.

Other Teacher Behaviors of the Growth Set

11. Identifying Inquiry Processes

As the students begin testing their ideas, the next major concern of the teacher is to help them become aware of the various inquiry processes they are using. To do so, he may use a teacher behavior called Identifying Inquiry Processes.

T: "Grant, you've just experimented as a way of getting some new data."

T: "Forrest, you've organized your data by plotting it on a graph."

12. Identifying Products of Inquiry

Inquirers must also learn to discriminate between data and theory. To help the students learn to make this discrimination, the teacher uses a similar teacher behavior called Identifying Products of Inquiry.

T: Maylon, you have a theory about . . . .

T: Gary, you have some new data about. . . .

13. Probe for Intent or Function

As a way of helping the students consider what good the various inquiry processes are to them, the teacher may question certain students about why they did what they did or how the process they used helped them in their work. This is called a Probe for Intent or Function.

T: Dennis, why are you experimenting? To build a theory or to test one?

T: Ann, how did checking the data in the almanac help you test your theory?

T: Kurt, what good is a theory in your inquiry?

14. Probe for Prediction or Explanation

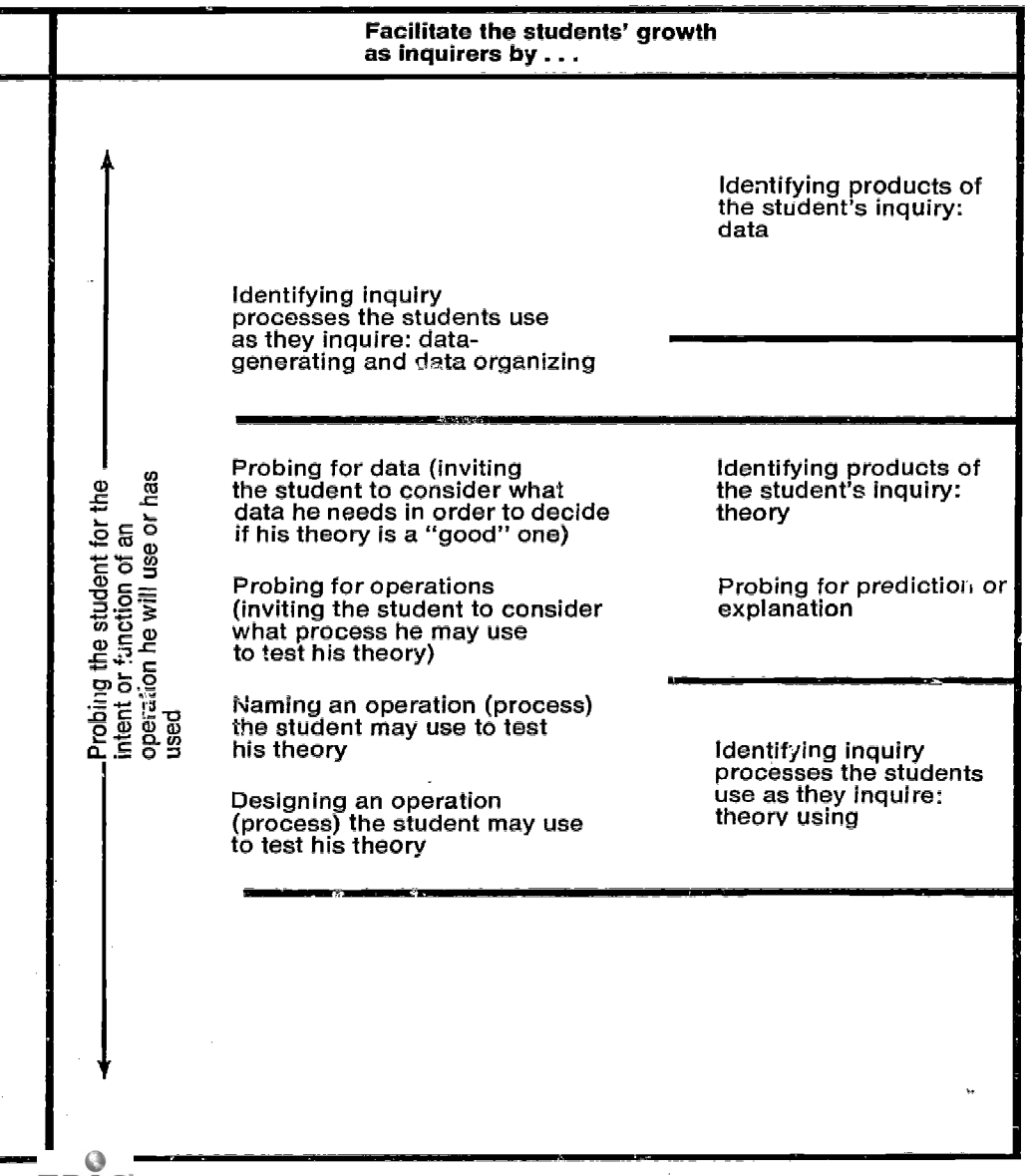
As a way of helping the students explore the power and/or limitations of their theories, the teacher may use a Probe for Prediction or Explanation.

T: Vinnie, what do you predict will happen if we dry the head of the dunking duck? Will it still bob up and down, will it move more quickly, will it stop, or what? What do you think?

T: Fritz, does your theory explain why people are moving out of the larger cities, or just why no new people are moving in?

Alternative Ways of Interacting with Students

When the students use	The teacher may
Data-Generating Processes e.g., Observing, counting, interviewing, voting, measuring, experimenting, using books, films, filmstrips, and other secondary data sources **Data-Organizing Processes** e.g., writing, listing, drawing, taking pictures, graphing, charting, using various recording instruments, classifying, computing, collating, labeling, enumerating **Data-Using Processes** e.g., Inferring, synthesizing, explaining, theorizing, generalizing, abstracting, concluding, making analogies **Theory-Using Processes** e.g., Predicting, hypothesizing, modeling, identifying assumptions inherent in a theory, interpolating, extrapolating **Identifying a Problem Suitable For Inquiry**	


Facilitate the students' growth as inquirers by . . .
Probing the student for the intent or function of an operation he will use or has used
Identifying products of the student's inquiry: data
Identifying inquiry processes the students use as they inquire: data-generating and data organizing
Probing for data (inviting the student to consider what data he needs in order to decide if his theory is a "good" one)
Identifying products of the student's inquiry: theory
Probing for operations (inviting the student to consider what process he may use to test his theory)
Probing for prediction or explanation
Naming an operation (process) the student may use to test his theory
Designing an operation (process) the student may use to test his theory
Identifying inquiry processes the students use as they inquire: theory using

Generating Information About the Students:

The Diagnostic Set of Teacher Behaviors

As the teacher observes his students at work, he can learn much about how they go about solving problems—about their repertoire of inquiry processes and strategies. As he observes their responses to the growth set of teacher behaviors, that is, as he "reads" the effects of these behaviors on the students, he gains additional insight into their present abilities to inquire. At times, however, he will want to take direct action to generate some additional data about the students that may not otherwise be apparent.

15. Probe for Student's Theory

When students first participate in inquiry activities, many begin work by stating their theories. But as their repertoire of data-generating and data-using processes develops, most students begin to take some action to test out their ideas before they state them to the group. Some students may work on theories which they never state at all.

In the case of a student who has not stated his theory, but all of whose operations seem to revolve about a particular idea, the teacher may want to use a Probe for Student's Theory.

T: Bob, would you mind sharing your theory with us? If you have one, that is. . . .

T: Pam, what is your theory about what happened to this town?

16. Probe for Status of Student's Theory

As a student works on a problem he may find that his theory is supported by the data, that it is in need of revision, or that it should be discarded. Frequently he will come to one of these conclusions without making any comment about it. Because inferences about a student's growth as an inquirer are drawn in part from the bases on which he keeps, modifies, or discards a theory, there are occasions on which the teacher will want to use a Probe for the Status of Student's Theory.

T: How do you feel about your "old junky places" theory now, Fritz?

As with other teacher behaviors that begin with the term "probe," the teacher should use this one only when he is reasonably certain that the student *will be able to respond*. And, so that use of this teacher behavior does not provide a cue that the student's theory is "wrong," the probe for status of a student's theory should be used when the student's theory *does* match the data he has generated as well as when it does not.

17. Probe for Feelings

We have noted various ways in which the teacher can offer help to students who appear unable to test their theories on their own. Some students at this stage, disillusioned and feeling they are getting nowhere, will lose interest in the activity unless they are given help. Other students at the same stage, however, will prefer to go on matching their wits with the problem in their own ways. How a student feels about himself and his work is the basis on which the teacher must decide when to help and when not to. He can find out the student's inclinations by using a Probe for Feelings.

T: How do you feel about what we've being doing?

T: How do you feel about how we've been working?

It should be noted that feelings of frustration at not being told which theory is "right" are common in first inquiry activities. They result from the students' *wanting* to solve the problem (the problem was suitable for them because they *wanted* to solve it) but being unable to do so because of their limited repertoire of inquiry processes and strategies.

Feelings of frustration are vital if the students are to become more effective inquirers. Frustration creates the need for students to talk about and experiment with different ways of working. It is these feelings that make group discussion about ways of working so relevant.

Learning to inquire involves learning to deal with oneself, with the frustrations that arise in attempting to solve a problem one feels is important. If, for example, the students comment that they are upset because the teacher won't tell them which theory is right, or because they don't know how to tell when they're right (what a case this makes for inquiry to be a part of all curricula!), the teacher may respond as follows:

"I understand your concern, Fred. (Accepting) How can you tell for yourself when a theory is a good one?" (Probe for Operations)

"Is there anyone in the group who feels his theory looks like a good one? (Probe for Status of Student's Theory) What is it that tells you your theory seems to be a good one? I didn't say so." (Probe for Prediction or Explanation)

In this way the students' frustrations may lead into a process dialogue about the issue, "How do you know when a theory is a good one?" The issue will probably not get resolved during the first process dialogue, but it will start the students thinking. And raising this issue for the students implies that they are able to identify good theories by themselves. As this question is revisited before and after future inquiry activities, the students' comments will clearly reveal what they are learning.

As their repertoire of data-generating, data-organizing, data-using, and theory-using processes develops, the students' feelings of frustration diminish. And their feelings of intellectual power as inquirers grow.

Alternative Ways of Interacting with Students

When the students use

Data-Generating Processes
e.g., Observing, counting, interviewing, voting, measuring, experimenting, using books, films, filmstrips, and other secondary data sources

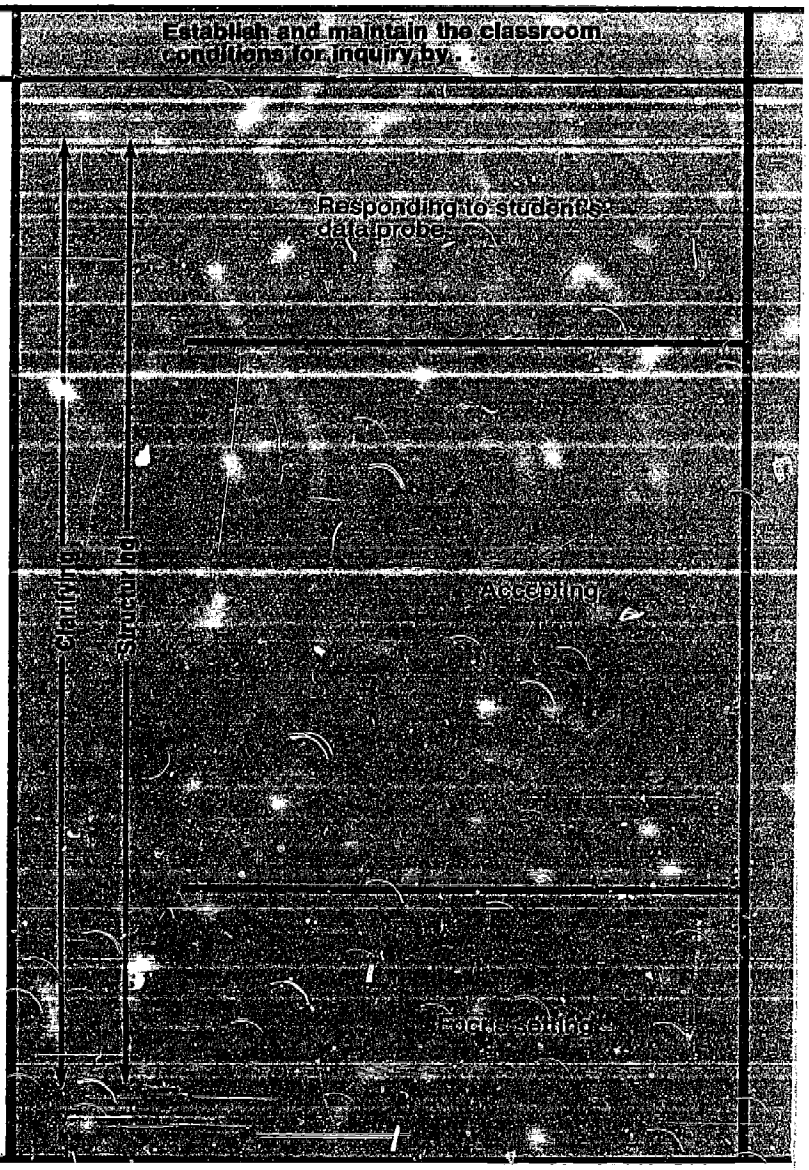
Data-Organizing Processes
e.g., writing, listing, drawing, taking pictures, graphing, charting, using various recording instruments, classifying, computing, collating, labeling, enumerating

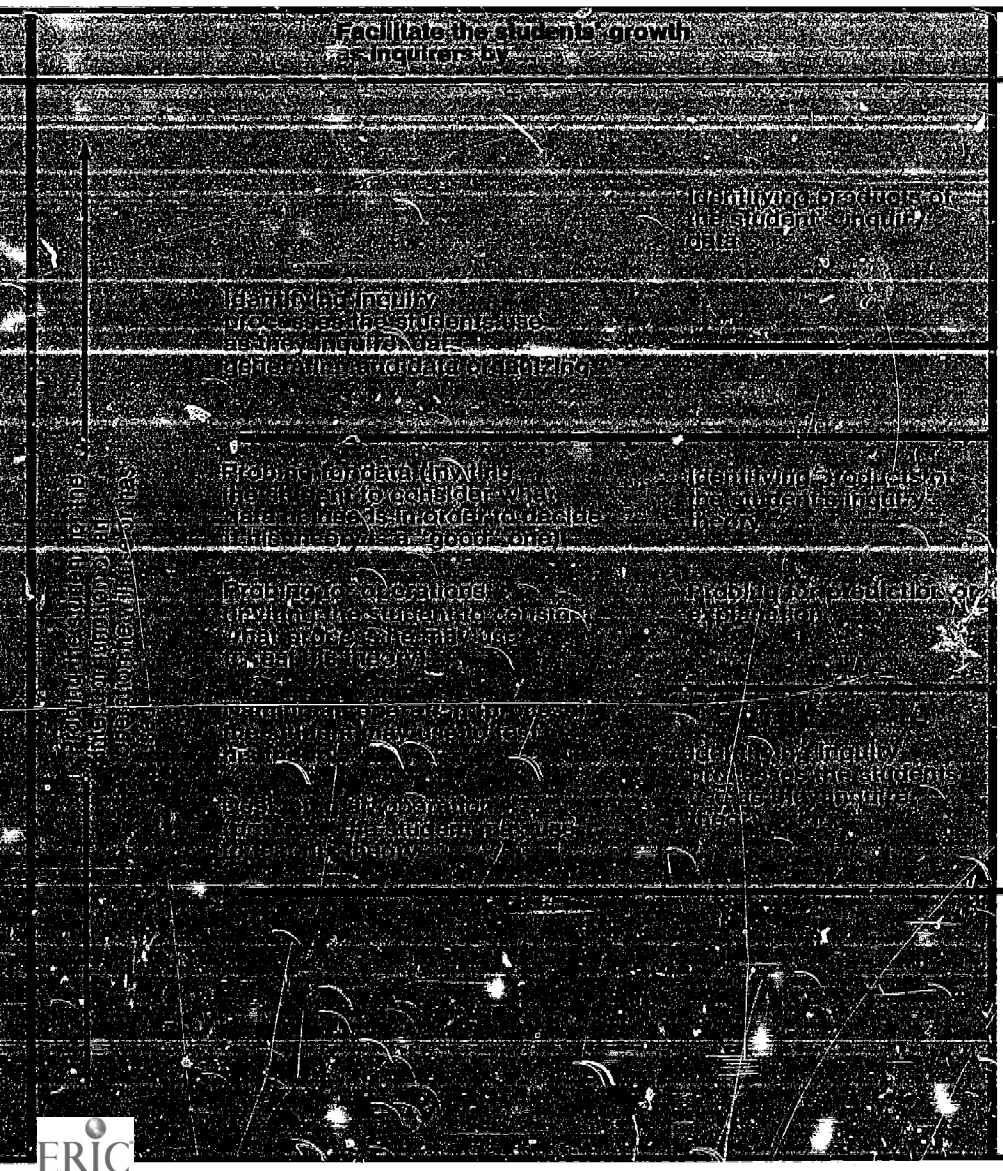
Data-Using Processes
e.g., Inferring, synthesizing, explaining, theorizing, generalizing, abstracting, concluding, making analogies

Theory-Using Processes
e.g., Predicting, hypothesizing, modeling, identifying assumptions inherent in a theory, interpolating, extrapolating

Identifying a Problem Suitable For Inquiry

The teacher may



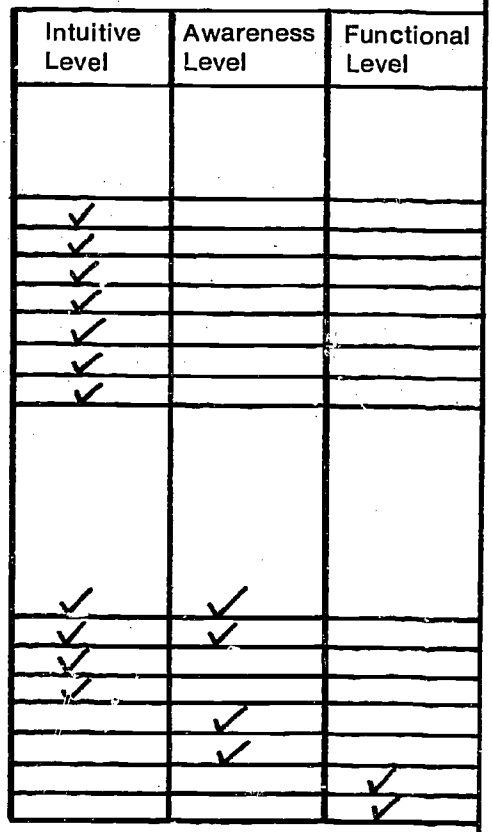


Facilitate the students' growth as inquirers by . . .	Generate diagnostic data about the students' work as inquirers by . . .
Identifying procedures of the student's inquiry	Probing for operations (seeing if the student knows the name of the operation he has used)
Identifying inquiry processes the student uses as they inquire; helping him generate new data or organize his data	
Probing for data (inviting the student to consider what data he needs in order to decide if his theory is a good one)	Probing for the status of the student's theory (inviting him to report how he feels about a theory he has been working on)
Identifying the student's inquiry theory	
Probing for operations (inviting the student to consider what procedures he used in order to test his theory)	Probing for evaluation of information
Probing for evaluation of information	
Identifying inquiry processes the student uses in order to test his theory	Probing for the student's theory (inviting student to report the theory he is working on)
Probing for the student's theory (inviting student to report the theory he is working on)	

Teacher Behaviors As Related to the Process Learning Sequence

If the teacher behaviors we have discussed are viewed in the context of the process learning sequence (from the intuitive, through the awareness, to the functional stages of growth), each behavior may be related to the stage of a student's development it most directly influences.

The teacher behaviors of the diagnostic set are not included in this chart because their main purpose is to provide data for the teacher rather than to directly influence the student's growth in a predetermined, predictable way.



The Process Dialogue

If students are to learn to read, whatever else they do, they should read. But learning to read involves more than having a book in hand. Dialogue between the students and their teacher about what they have read is also important. The students discuss words they didn't know and meanings they were able to figure out for themselves. In learning to read, then, the students spend most of their time reading and some of their time in an open dialogue with their teacher and other students.

The same is true of students learning to inquire. They spend most of their lesson time working to solve problems suitable for their inquiry and some of their time in a dialogue about what they did as they worked, what they learned about solving problems, the difficulties they encountered, and what they plan to do differently when they work on their next problem.

The inquiry activity is organized into these two discrete parts because of the way people think and work comfortably. When anyone is caught up in working to solve a problem, it is difficult for him to interrupt his thinking to discuss something else. Ideal times for process dialogue, therefore, are as students prepare to work, when ways of working are likely to be a prime concern, and when work on the problem has stopped, either because the problem has been solved (and another productive strategy thus discovered) or because the inquirers have "run dry" and need help from others.

The process dialogue is a group activity, while the actual inquiry is an individual effort. The opportunity to tell others about how he has worked forces each student to conceptualize what he has done. The dialogue raises new issues for the students' consideration and provides new alternatives for exploration by all those involved in the discussion.

As the students' ability to discuss various theory-seeking and theory-testing strategies grows, each inquiry problem becomes an opportunity to explore new strategies they have formulated.

Presession process dialogue:
Students *theorize* about theory-seeking and/or theory-testing strategies they want to try.

Work on the problem:
Students *test out* the strategies they have formulated.

Postsession process dialogue:
Students *evaluate* the theory-seeking and/or theory-testing strategies they used, identify advantages, and suggest revisions for next time.

Illustrative Questions for the Process Dialogue

Frequently students will raise questions that are excellent topics for discussion. The teacher must provide the time and "legitimate" status leading to a productive discussion of them. If necessary, he can supplement the questions and issues raised by the students with a few of his own. The following examples may be used to stimulate thought and action by students at several age levels. The teacher should choose those he finds most appropriate.

General Strategy Questions

How do you decide what to do as you work on a problem?

How do you know when a problem is solved?

Theory-Seeking Questions

What can you do to get started on a new problem when you don't have a theory?

When you don't have a theory and you want to get started by generating data, how do you decide what data to get?

When you've started work on a problem by generating data—in search of a theory—how do you decide which data are important and which can be forgotten? (consequential variables)

Theory-Testing Questions

Once you have a theory, how might you go about testing it to find out if it is a good one?

When you have more than one theory to explain the same thing, how can you find out which one is better (more powerful)?

Do any of you have a theory you think is a good one in relation to the problem we've been working on? How do you know?

Do any of you have a theory you feel is no good—or that you want to think about some more? How did you decide it was no good?

Questions About Data and Data-Generating, Data-Organizing, and Data-Using Processes

What are data?

What good are data?

What are good data?

How do you decide what data you need as you work on a problem?

How do you decide what you will do to get the data you feel you need?

What are some different ways to generate data? How do you decide which one to use?

When—under what conditions—would you experiment to generate data?

How is an experiment different from a verification operation?

What can you do to make certain that the data you get are good data?

How do you know whether or not you need to organize your data?

How do you decide how you'll organize your data?

In what ways do you use data?

How do you decide what the data you get mean in relation to your theory?

How do you decide what your theory will and will not predict?

How do you know when to discard a theory? On what basis?

How do you decide how to revise a theory?

In what ways are theories related to data?

Questions About Theories and Theory-Using Processes

What is a theory?

Is there any difference between a theory and someone's opinion?

What is a good theory?

Can you ever know for sure if a theory is "right"? Can you ever prove a theory true? Under what conditions? What kinds of theories?

What good is a theory?

What are some ways you use a theory?

How do you use a theory (or theories) to build an explanation?

Postsession Questions

What will you do differently next time we work?

Have you learned anything new about working on problems from your work today?

Does anyone have anything to add to the chart of problem-solving strategies? Is there anything you'd like to change?

Did anyone try . . . (referring to a strategy outlined on the chart of problem-solving strategies) as you worked today? How did it work for you?

How do you decide which problems are inquirable and which are not?

How is your work on this problem similar to (or different from) your work on . . . problem? (problems of the same and different content areas)

The critical issue in the process of education is not whether all teachers should teach toward the same objectives. It is, rather, how all teachers can come to know what objectives they seek and how best to attain them.

The importance of objectives in instruction has been stated often over the years. Many educators agree that good teaching *must* be directed toward specified purposes. We have, therefore, developed goals and objectives both for the student who is increasing his power as an inquirer and for the teacher who is sharpening his ability to teach toward inquiry.

Some in the educational enterprise view objectives as mechanical decorations set forth to satisfy a required way of stating the curriculum, but serving no useful purpose. Indeed, some statements of objectives are so vague and nebulous that it is quite understandable that this notion should exist. The reverse—simplistic, narrowly stated behavioral objectives—causes an equally adverse reaction from the thoughtful, creative teacher. But statements of objectives need not be ornaments in a formally stated curriculum, nor a brake on creativity and independence. Rather, if carefully and precisely phrased they provide *guidance* for the student, teacher, administrator, budget analyst, and consultant—indeed, for all involved in instructional decision making.

Useful objectives, carefully and precisely stated, provide guidance in—

Selection of Content

As used here, *content* refers to process as well as to information from a body of knowledge. Guidance to the teacher in the selection of content to be emphasized in the teaching/learning situation is given in the "content dimension" of an objective. For example, with an objective such as "Uses a range of theory-seeking and theory-testing strategies as he works on problems of different content areas," the content called for is "theory-seeking and theory-testing" (process content) in "problems of different content areas" (knowledge content).

Identification of Student Behavior Sought

A carefully stated objective includes some reference to the behavior sought in the teaching/learning situation. With the content, "a range of strategies as he works on problems of different content areas," what is it we wish the student to do? Do we want him to be able to *recall* a range of strategies? Do we want him to *identify* a range of strategies that he and others in the class have used? We want him to *use* a a range of theory-seeking and theory-testing strategies as he works on problems of different content areas. What the student is to *do* is the behavioral dimension of the objective. Specifying the behavior in an objective facilitates putting in sequence the student behaviors sought, from entering to complex practiced behavior.

Selection of a Teaching Strategy

An objective that contains a precise statement of the student behaviors sought guides the teacher in the selection of relevant learning opportunities: how students are to work, what they are supposed to learn, what materials will be used, and how they will be organized for learning. Obviously, if a student is to develop a particular behavior there must be opportunities for him to practice this behavior—to "do" the behavior outlined in the objective.

Evaluation of Change in Student Behavior

To prevent haphazard evaluation, precisely stated objectives are crucial. The specification of an objective such as "Groups two or more inquiry processes into a sequence to build or test a theory" requires assessing progress on this specific behavior. Without objectives clearly in mind, the tendency of the teacher may be to evaluate the student's growth only on the basis of his ability to recall, rather than on a range of more highly valued behaviors.

A carefully stated objective is useful also to the students. When students are aware of the objectives that underlie instruction, these objectives serve as one kind of benchmark for them, so they can see where they have been, where they are, and where it is possible for them to go.

Evaluation of Teacher Behavior

In addition to serving as criteria for evaluation of student growth, objectives for instruction may help a teacher evaluate his own behavior. Change or lack of anticipated change in the behavior of some students becomes a base from which inferences may be drawn about the effect of the teacher's instructional behavior on the entire class. If his behavior did not facilitate student growth, what alternative ways of working are open to him?

Goals for Students Learning To Inquire

One of the goals of education as we see it is to help students become more productive, systematic, and autonomous problem solvers. When students solve problems on their own, as opposed to having the teacher either directly or indirectly solve them, the students are inquiring.

If inquiry-oriented teaching is different from the development of a certain body of content or from having the students practice certain skills, how does a teacher tell whether his teaching is effective? Toward what objectives is inquiry-oriented teaching directed? How do students behave differently as they get better at inquiring?

Goal Level I
Getting Involved

At Goal Level I, the student enters the inquiry activity through apparently random generating of data and presenting of his ideas or theories in relation to the problem. He experiences both the frustrations of trying to solve a problem on his own and the exhilaration of becoming increasingly productive in building explanations that match the data he or others in the group generate.

Goal Level II
Exploring the Tools of the Inquirer

At Goal Level II, the student uses his theories as a point of departure for his inquiry. He is able to label the data-generating processes he uses. Thus, these processes become discrete elements of his conscious behavior which he is able to talk about. He also begins to use data-organizing and data-using processes as he works.

Goal Level III
Developing a Repertoire of Inquiry Processes

At Goal Level III, the student knows what specific information he needs in order to substantiate the theory(ies) on which he is working. He translates this need for information into data-generating processes, and then into data-organizing, data-using, and theory-using processes.

Goal Level IV
Developing a Repertoire of Inquiry Strategies

At Goal Level IV, the student's use of theory-using processes gives rise to the emergence of a repertoire of theory-testing strategies. Using concepts of objects, systems of objects, conditions, events, people, places, and/or feelings leads to the emergence of theory-seeking strategies.

Goal Level V
More Autonomous Inquiry

At Goal Level V, the student's inquiry is essentially internally motivated and voluntarily implemented. A typical teacher–student relationship no longer exists during the inquiry activity. The teacher's major role with a student who works at this level is to support his inquiry by giving him time to work and by facilitating his generation of data.

Illustrative Objectives for Students

The objectives we will identify for students learning to inquire will be classified according to the five goal levels just listed. These objectives become one basis for making decisions about student growth.

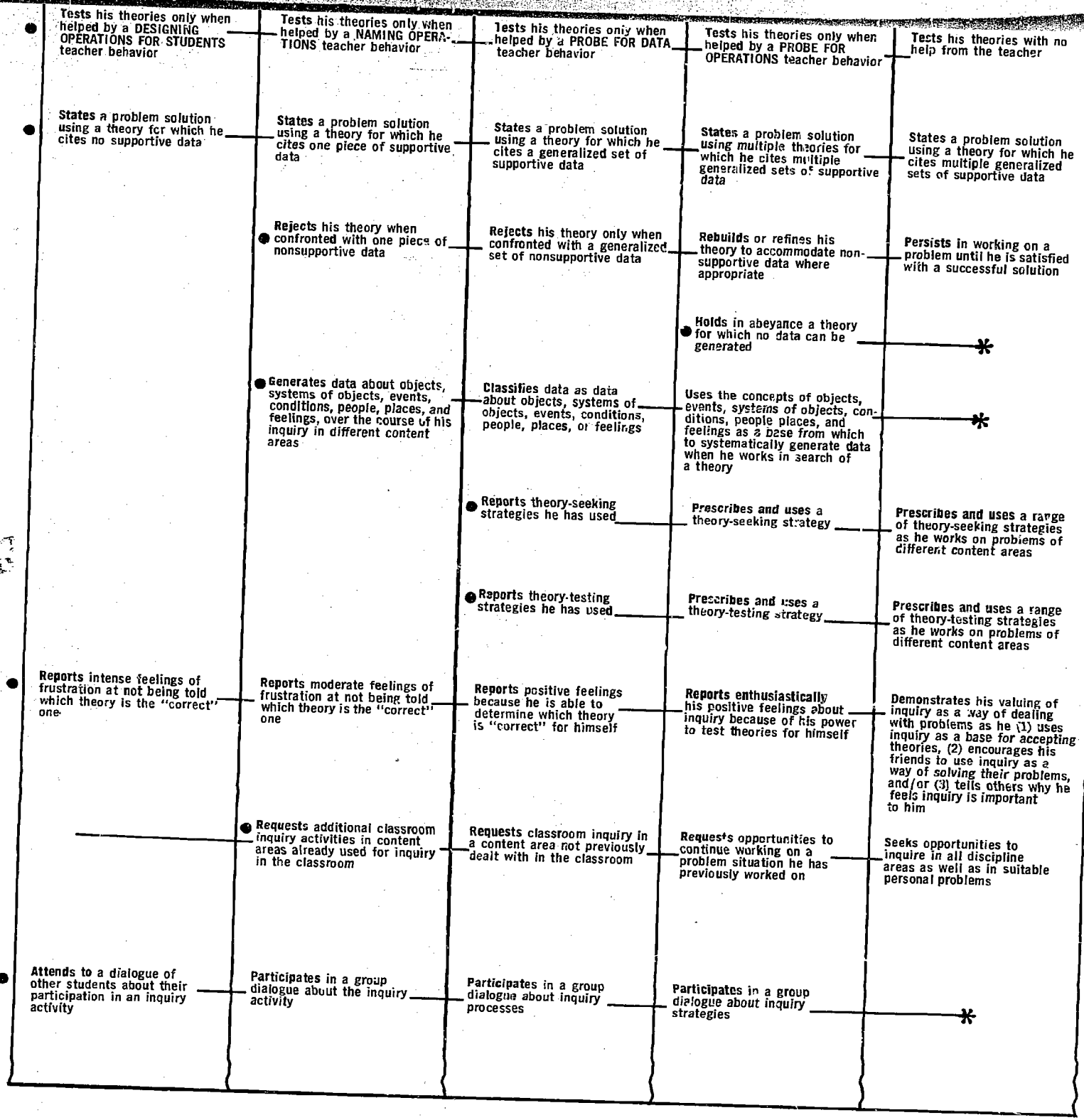
Each time a student works on a problem it is possible to relate his work to our taxonomy of objectives. However, his behavior will usually be found to range over several goal levels. The problem then is to determine the goal level at which a student is working. Goal attainment for a student may be assumed when *most* of his behavior can be ascribed to the objectives for a given goal. The objectives we are about to identify do not include the conditions under which the student should attain them, nor do they specify how well the student should perform. The inclusion of these two elements would, of course, make the objectives more specific. By design they have *not* been stated because they cannot be identified apart from an individual teacher's teaching situation and value system.

Our objectives have been formulated so that they relate to the student's work in any content area and to his participation in the process dialogue.

The objectives we have identified are not the only ones to be attained. Rather, they are the *priority* objectives in teaching toward inquiry. It is quite possible and perhaps even desirable to specify at each goal level an array of additional objectives appropriate for a particular group of students. Certainly any teacher engaged in professional inquiry—his own inquiry into teaching toward inquiry—will identify restatements to be formulated and additions to be made.

Illustrative Objectives for Students Learning To Inquire

Goal Level I Getting Involved	Goal Level II Exploring the Tools of the Inquirer	Goal Level III Developing a Repertoire of Inquiry Processes	Goal Level IV Developing a Repertoire of Inquiry Strategies	Goal Level V More Autonomous Inquiry
● Makes a comment or poses a question about the structure of the inquiry activity				
● Works to solve problems presented to him by the teacher	Suggests a subproblem of his own while working on a problem presented by the teacher	Suggests a problem of his own related to the specific content of other-than-inquiry classroom work	Suggests a problem of his own unrelated to the specific content of other-than-inquiry classroom work	*
● Uses data-generating processes	Uses data-generating, data-organizing, and data-using processes	Uses data-generating, data-organizing, data-using, and theory-using processes	Uses data-generating, data-organizing, data-using, theory-using, and data-validating processes	*
	● Labels the specific data-generating processes he uses	Labels the specific data-generating, data-organizing, and data-using processes he uses	Labels the specific data-generating, data-organizing, data-using, and theory-using processes he uses	Labels the specific data-generating, data-organizing, data-using, theory-using, and data-validating processes he uses
		● Uses a wide range of data-generating processes during the course of his work on different problems	Uses a wide range of data-generating, data-organizing, and data-using processes during the course of his work on different problems	Uses a wide range of data-generating, data-organizing, data-using, and theory-using processes during the course of his work on different problems
		● Formulates data-generating processes that include all relevant information about such factors as time, weight, condition, location, etc.	*	*
	● Labels the products of his inquiry as data or theory	Reports the function of data and/or theory in his inquiry	*	*
	Responds to other students who wish to discuss their theory(ies) with him	*	*	*
● Initiates action to engage others in a dialogue about the problem	Initiates action to engage others in a dialogue about his theory(ies)	Uses other students' data and theories in his work on a problem	*	*


Tests his theories only when helped by a DESIGNING OPERATIONS FOR STUDENTS teacher behavior
Tests his theories only when helped by a NAMING OPERATIONS teacher behavior
Tests his theories only when helped by a PROBE FOR DATA teacher behavior
Tests his theories only when helped by a PROBE FOR OPERATIONS teacher behavior
Tests his theories with no help from the teacher
States a problem solution using a theory for which he cites no supportive data
States a problem solution using a theory for which he cites one piece of supportive data
States a problem solution using a theory for which he cites a generalized set of supportive data
States a problem solution using multiple theories for which he cites multiple generalized sets of supportive data
States a problem solution using a theory for which he cites multiple generalized sets of supportive data
Rejects his theory when confronted with one piece of nonsupportive data
Rejects his theory only when confronted with a generalized set of nonsupportive data
Rebuilds or refines his theory to accommodate nonsupportive data where appropriate
Persists in working on a problem until he is satisfied with a successful solution
Holds in abeyance a theory for which no data can be generated
*
Generates data about objects, systems of objects, events, conditions, people, places, and feelings, over the course of his inquiry in different content areas
Classifies data as data about objects, systems of objects, events, conditions, people, places, or feelings
Uses the concepts of objects, events, systems of objects, conditions, people places, and feelings as a base from which to systematically generate data when he works in search of a theory
*
Reports theory-seeking strategies he has used
Prescribes and uses a theory-seeking strategy
Prescribes and uses a range of theory-seeking strategies as he works on problems of different content areas
Reports theory-testing strategies he has used
Prescribes and uses a theory-testing strategy
Prescribes and uses a range of theory-testing strategies as he works on problems of different content areas
Reports intense feelings of frustration at not being told which theory is the "correct" one
Reports moderate feelings of frustration at not being told which theory is the "correct" one
Reports positive feelings because he is able to determine which theory is "correct" for himself
Reports enthusiastically his positive feelings about inquiry because of his power to test theories for himself
Demonstrates his valuing of inquiry as a way of dealing with problems as he (1) uses inquiry as a base for accepting theories, (2) encourages his friends to use inquiry as a way of solving their problems, and/or (3) tells others why he feels inquiry is important to him
Requests additional classroom inquiry activities in content areas already used for inquiry in the classroom
Requests classroom inquiry in a content area not previously dealt with in the classroom
Requests opportunities to continue working on a problem situation he has previously worked on
Seeks opportunities to inquire in all discipline areas as well as in suitable personal problems
Attends to a dialogue of other students about their participation in an inquiry activity
Participates in a group dialogue about the inquiry activity
Participates in a group dialogue about inquiry processes
Participates in a group dialogue about inquiry strategies
*

Goals for Teachers Learning To T[illegible] Toward [illegible]

Goals for teachers who are sharpening their effectiveness in teaching toward inquiry specify in a developmental way what the teachers must be able to do as they work with their students. These goals are based on the premise that the teacher is willing to participate in an in-service series designed to help him improve his ability to teach toward inquiry. In this instance "is willing" means the teacher agrees to—

Experiment with ways of organizing the classroom and the students.

Experiment with ways of behaving toward process goals.

Use problem situations in the classroom for which his preparation is required.

Let other adults in the group listen to him interacting with his students.

Goal Level I
Reading the Students' Inquiry Behavior

At Goal Level I the teacher is able to classify two groups of inquiry processes used by students as they work: data-generating and data-using processes. He is also able to relate these processes to the data-theory loop model of inquiry in order to reveal ways in which the processes are interrelated.

Goal Level II
Creating the Classroom Conditions for Inquiry

At Goal Level II the teacher is able to create the conditions for inquiry in the classroom. He is able to arrange things so that students have the opportunity to work on a problem, have the freedom to seek out the information they want, when they want it, and have an environment where information is available to them when they seek it without judgment on the results. He is also able to classify the students' data-organizing and theory-using operations.

Goal Level III
Facilitating the Students' Growth as Inquirers

At Goal Level III, the teacher is able to identify where a given student inquiring into a particular problem is in relation to the illustrative objectives for students learning to inquire. He is able to choose those teacher behaviors that facilitate the students' growth as inquirers. He also uses the process dialogue with his students before and/or after they work on a problem.

Goal Level IV
Generating Diagnostic Data About the Students' Behavior

At Goal Level IV the teacher uses those teacher behaviors through which diagnostic data may be generated about the students. He is able to generate these data both during an inquiry activity and during process dialogue.

Goal Level V
Inquiring into Teaching

At Goal Level V the teacher is able to inquire into instruction designed to help students grow as inquirers. He searches for more productive ways of behaving as a teacher and is skillful in helping other teachers understand and use inquiry as a way of learning and a way of teaching.

Illustrative Objectives for Teachers

The objectives for teachers learning to teach toward inquiry are classified according to the five goal levels just identified. These objectives become one basis for determining teacher attainment of the various goal levels.

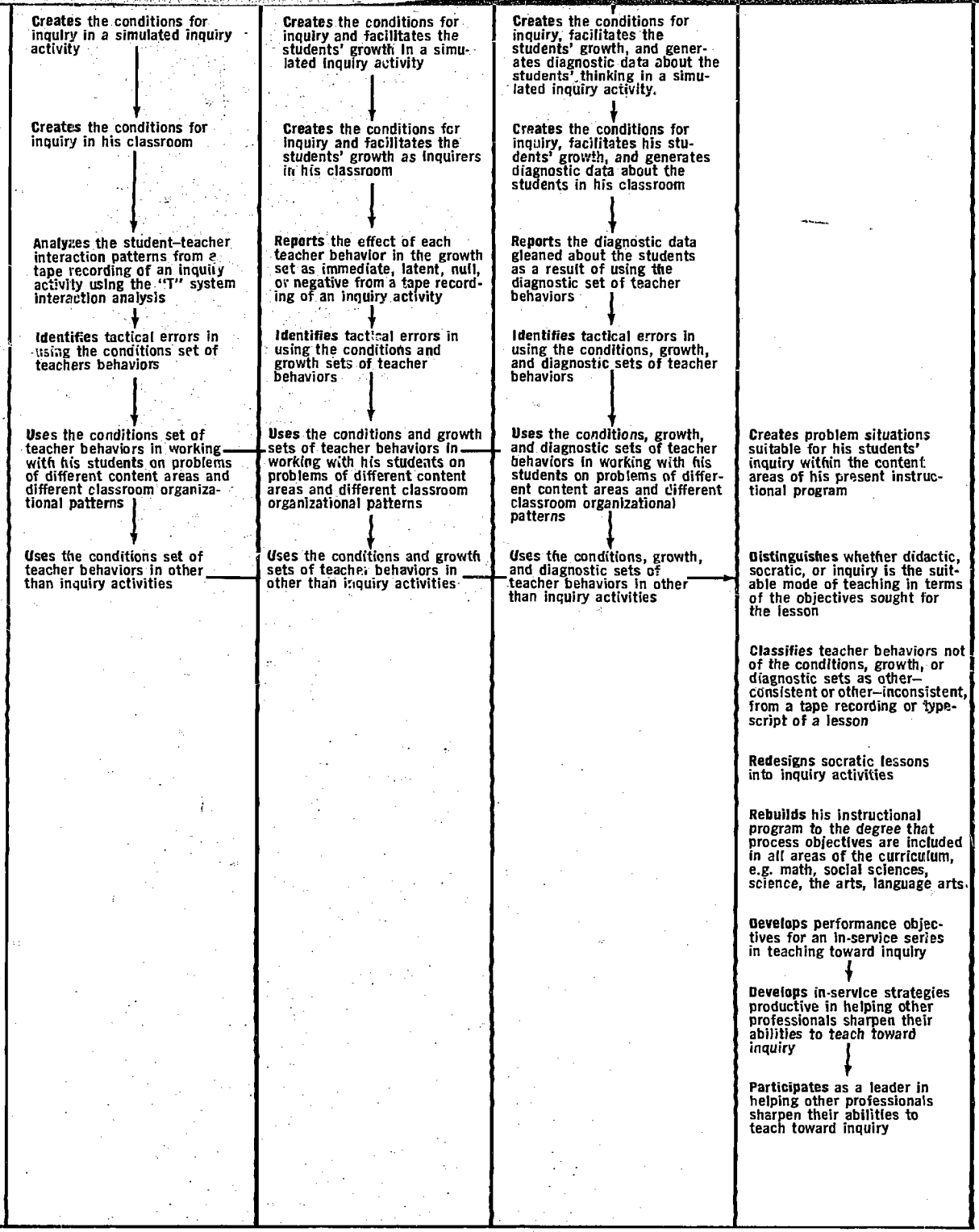
The objectives do *not* include the conditions under which they should be attained, nor do they specify how well the teacher should perform. This information should be included, however, in the specific performance objectives formulated for each in-service workshop series.

The following list is intended to be illustrative, not comprehensive. It is not intended to outline teacher competencies in relation to all modes of teaching. Rather, it suggests a developmental sequence for teachers engaged in sharpening their ability to teach toward inquiry.

The specification of instructional objectives will probably not cure all the problems that face the educator, but then, what *single* endeavor will? The development of statements of objectives within any educational program usually contributes to a clearer description of the program. This is true whether we consider teaching toward inquiry in the classroom or an in-service series for teachers. A description of objectives for students may provide clearer identification of what we call an educated individual. This kind of description for teachers provides a basis on which teaching toward inquiry may be differentiated from other modes of teaching.

Illustrative Objectives for Teachers Learning To Teach Toward Inquiry

Goal Level I Reading the Students' Inquiry Behavior	**Goal Level II** Creating the Classroom Conditions for Inquiry	**Goal Level III** Facilitating the Students' Growth as Inquirers	**Goal Level IV** Generating Diagnostic Data About the Students' Behavior	**Goal Level V** Inquiring into Teaching
Classifies data-generating and data-using processes and problems for inquiry from a list of statements made and questions asked by students during an inquiry activity		**Classifies** a list of data statements into data about objects, events, systems of objects, conditions, people, places, and/or feelings	**Classifies** data from an audio or video tape of an inquiry activity into data about objects, events, systems of objects, conditions, people, places, and/or feelings	
Classifies data-generating and data-using processes and problems for inquiry from an edited tape recording of an inquiry activity				
Classifies data-generating and data-using processes and problems for inquiry from a kinescope or video tape of an actual inquiry activity				
Classifies data-generating and data-using processes and problems for inquiry from a tape recording of an inquiry activity in which he worked as an inquirer				
Relates the students' data-generating and data-using processes to the data–theory loop model of inquiry	**Classifies** data-generating, data-organizing, data-using, and theory-using processes from an audio tape or video tape of an inquiry activity	**Relates** the students' behavior to the illustrative objectives for inquirers	**Identifies** changes in the students' behavior in relation to the illustrative objectives for inquirers	**Predicts** changes that will occur in the students' work as inquirers
	Classifies teacher behaviors of the conditions set from an edited audio tape recording of an actual inquiry activity	**Classifies** teacher behaviors of the conditions and growth sets from an edited tape recording of an actual inquiry activity		
	Classifies teacher behaviors of the conditions set from a list of teacher's statements and questions drawn from an actual inquiry activity	**Classifies** teacher behaviors of the conditions and growth sets from a list of teacher's statements and questions drawn from an actual inquiry activity	**Classifies** teacher behaviors of the conditions, growth, and diagnostic sets from a list of teacher's questions and statements drawn from an actual inquiry activity	
	Classifies teacher behaviors of the conditions and growth sets from a kinescope or video tape of an inquiry activity	**Classifies** teacher behaviors of the conditions set from a kinescope or video tape of an inquiry activity		
	Creates teacher behaviors of the conditions and growth sets in response to a written list of students' statements and questions drawn from an actual inquiry activity	**Creates** teacher behaviors of the conditions set in response to a written list of students' statements and questions drawn from an actual inquiry activity	**Creates** teacher behaviors of the conditions, growth, and diagnostic sets in response to a written list of students' statements and questions drawn from an actual inquiry	


Creates the conditions for inquiry in a simulated inquiry activity
Creates the conditions for inquiry in his classroom
Analyzes the student–teacher interaction patterns from a tape recording of an inquiry activity using the "T" system interaction analysis
Identifies tactical errors in using the conditions set of teachers behaviors
Uses the conditions set of teacher behaviors in working with his students on problems of different content areas and different classroom organizational patterns
Uses the conditions set of teacher behaviors in other than inquiry activities
Creates the conditions for inquiry and facilitates the students' growth in a simulated inquiry activity
Creates the conditions for inquiry and facilitates the students' growth as inquirers in his classroom
Reports the effect of each teacher behavior in the growth set as immediate, latent, null, or negative from a tape recording of an inquiry activity
Identifies tactical errors in using the conditions and growth sets of teacher behaviors
Uses the conditions and growth sets of teacher behaviors in working with his students on problems of different content areas and different classroom organizational patterns
Uses the conditions and growth sets of teacher behaviors in other than inquiry activities
Creates the conditions for inquiry, facilitates the students' growth, and generates diagnostic data about the students' thinking in a simulated inquiry activity.
Creates the conditions for inquiry, facilitates his students' growth, and generates diagnostic data about the students in his classroom
Reports the diagnostic data gleaned about the students as a result of using the diagnostic set of teacher behaviors
Identifies tactical errors in using the conditions, growth, and diagnostic sets of teacher behaviors
Uses the conditions, growth, and diagnostic sets of teacher behaviors in working with his students on problems of different content areas and different classroom organizational patterns
Uses the conditions, growth, and diagnostic sets of teacher behaviors in other than inquiry activities
Creates problem situations suitable for his students' inquiry within the content areas of his present instructional program
Distinguishes whether didactic, socratic, or inquiry is the suitable mode of teaching in terms of the objectives sought for the lesson
Classifies teacher behaviors not of the conditions, growth, or diagnostic sets as other–consistent or other–inconsistent, from a tape recording or typescript of a lesson
Redesigns socratic lessons into inquiry activities
Rebuilds his instructional program to the degree that process objectives are included in all areas of the curriculum, e.g. math, social sciences, science, the arts, language arts.
Develops performance objectives for an in-service series in teaching toward inquiry
Develops in-service strategies productive in helping other professionals sharpen their abilities to teach toward inquiry
Participates as a leader in helping other professionals sharpen their abilities to teach toward inquiry

First Classroom Interaction

We hope the following thumbnail sketch of an inquiry lesson will give you a feeling for what inquiry looks like with students. This particular activity was part of a unit in science.[1] The teacher used this lesson as an opportunity for his students both to apply concepts they had learned some weeks earlier about heat, change of state, and pressure, and to continue to develop their repertoire of theory-seeking and theory-testing strategies.

The teacher worked with a group of 12 students on the inquiry activity while a second group of 12 was watching a sound filmstrip related to the topic under study by the entire class and a third group of 12 was busy reading and carrying out some science investigations outlined in their textbook.

The teacher began work with the "inquiry group" after the other groups were at work. He planned to rotate the groups on following days so that all students would have a chance to participate in all three activities.

[1] This inquiry activity was first written up by Art Costa for *A Strategy for Science Instruction*, to be published by JS² Publishers, Hayward, Calif., in 1972.

Teacher Behavior	Student Behavior
"Today I'm going to show you a kind of science experiment. Then I'll pose a question about it. It will be your job to see if you can figure out how it works or why it works the way it does. OK?"	
"One thing I'll ask you to do is to raise your hand if you want to say something or ask some questions."	
The teacher holds up a pulse glass, a four-inch tube formed in a "U" shape. A one-inch glass globe is attached to each end of the "U" of the tube. One of the glass globes is partially filled with a red liquid. As he holds it so that all can see, he places his hand around this globe. The red liquid moves to the uncovered globe. He then places his other hand on the filled globe and takes his hand away from the empty one. The red liquid now moves back into the uncovered globe.	
"One question you might want to think about is why the red liquid moves."	
	Mike: "Is this thing a thermometer?"
"No."	
	Mike: "Does it work like a thermometer does?"
"It might."	
	Mike: "Hmm."

Teacher Behavior	Student Behavior
	Gina: "Do you squeeze it to make it go?"
"When you say 'squeeze it,' Gina, do you mean am I pressing in on the glass?"	
	Gina: "Yeah, I mean are you holding it real tight in your hand when it goes?"
"I'm holding it reasonably tight, but I'm not squeezing it real hard."	
	Gina: "Well, what makes it go, then?"
"That is your job. It's up to you to figure out what makes it go."	
	Maria: "Your hand's warm and that makes it go."
"Just a minute, Maria, I want to make sure that Gina is through. Gina, did you want to say anything else?"	
	Gina: "No."
"OK, now it's your turn, Maria."	
	Maria: "Well, is it?"
"Is what?"	
	Maria: "Is your hand warm?"

Teacher Behavior	Student Behavior
"Do you want to touch my hand so you can decide? Find out if it's warm."	
	Maria: "Sure. It's warmer than mine. Your hand is warm. Will it work with cold hands?"
"Do you want to try it to find out?	
	Maria takes the pulse glass and holds one side of it. The red liquid remains at the same level for a moment, but then moves slowly to the uncovered side.
	Maria: "Hey, it doesn't move as fast for me. Did you heat up your hand or something before you touched it?"
"No, I didn't."	
	Mike: "Can I try it too?"
"Sure. Maria, when you're through, would you please pass it to Mike?"	
	Maria: "In a minute, Mike, I'm not finished with my experiment yet."
	She places her other hand on the uncovered sphere and observes what happens. She turns the glass upside down and at several angles and observes the results.
	Maria: "Hey, I can make it run uphill!"

Teacher Behavior	Student Behavior
	Mike: "Let me try it now."
	Maria passes the pulse glass to Mike He places his hands over both spheres The red liquid does not move. He the places his hand around the tube con necting the two spheres. The red liqui does not move. Finally he places hi hand over one sphere and the liqui moves to the uncovered side.
	Mike: "Is this stuff in here mercury?
"No, it isn't."	
	Mike: "What is it?"
"Methyl alcohol."	
	Mike: "Methe . . . what?"
"Methyl alcohol."	
	Mike: "Well, could you use somethin else? Would it go with somethin else?"
"What would you like to use?"	
	Mike: "Water?"
"No, it wouldn't work if you used water."	
	Mike: "Is it the same stuff that's thermometers? Ya' know, that re stuff?"

Teacher Behavior	Student Behavior
"No, it's not the same."	
	Mike: "Well, is that how it works? Does the stuff inside there expand when you heat it like a thermometer goes up when it gets hot?"
"Let me see if I understand you, Mike. You're saying the liquid in here expands—takes up more room—is that what you mean?"	
	Mike: "Yeah, it gets bigger; you put your hand over it and the heat from your hand makes the red liquid get bigger so it has to take up more room and it moves to the other side."
"Oh, you have a kind of heat theory or expansion theory about what makes it go. It's up to you to figure out if your theory is a good one.	
	Gina: "If you were to put it in some place real cold, would it work?"
"What do you mean by 'cold place'?"	
	Gina: "Like, if I could take it into a refrigerator, would it work there?"
"You mean if you were to do everything the same—put your hand over it just like I did—but you did it in a refrigerator, would it work the same?"	
	Gina: "Yeah."

Teacher Behavior	Student Behavior
"Yes, it would work the same."	
"OK, let's stop here for now. Before we go to lunch, though, let me ask what you think of what we have done today, and how you feel about it."	
	Gina: "Are you going to tell us the answer?"
"No. That's what inquiry is all about—learning how to decide for yourself if your answer is a good one."	
	Gina: "You mean you're not going to tell us?"
"No, but I want to make it possible for you to work so you can tell for yourself."	
	Mike: "I think you wanted us to figure out the answers for ourselves rather than you telling us the answer. Is that what you want us to do?"
"Yes, to learn how to figure out answers for yourselves. Do any of you feel that you do have a good theory?"	
	Frank: "Yes, I think it's heat."
"How do you know your theory is a good one?"	
	Frank: "Because it is. When you put heat on it goes. Or when you take heat away with ice or something cold it goes the other way."

If the ideas outlined in this publication are to become general practice, the question of training the school staff must be considered. The authors of this publication have designed and conducted a 30-hour series designed to reach rather specific objectives in helping teachers develop skills in teaching toward inquiry. Readers will find the following schedule and other notes informative if they choose to move the ideas we have presented into formalized work with groups of teachers.

The series, which continues to be presented and redesigned,[1] is built on the following assumptions about inquiry:

Specific identifiable skills are required in teaching toward inquiry.

To teach toward inquiry requires experience as an inquirer.

The processes and products of inquiry are observable and can be classified.

One measure of growth as an inquirer is the degree of autonomy a student can assume in building and testing ideas.

It is possible to produce and identify inquirer growth.

There are specific, identifiable teacher behaviors that support the growth of inquirers toward behavioral objectives.

One measure of inquirer growth is how the student feels about himself in relation to the solving of problems.

A model of inquiry may be built from observable inquirer behaviors.

Specific teacher behaviors yield a predictable range of inquirer behaviors.

[1] For more recent modification of this strategy, the reader may write the authors at the Office of the Los Angeles County Superintendent of Schools, 155 W. Washington Blvd., Los Angeles, Calif. 90015.

. . . and on the following assumptions about in-service training:

A series should have prearranged structure with room built in so that individuals can influence the structure.

Experienced teachers have an operational set that facilitates or hinders growth in a specific behavior.

People learn to teach toward inquiry as a result of a wide variety of experiences.

Becoming a leader in training other adults requires special knowledge and skill.

Commitment to a change is essential to acceptance of it.

Involvement builds commitment.

For one to internalize a process, one must experience it.

There must be opportunities to practice the behaviors to be learned.

Participants must deal with obstacles in their own way.

Guidance in the effective use of a skill is essential to its implementation.

One further assumption is that there is a process growth sequence (intuitive-awareness-functional) through which both inquirers and teachers learning to teach toward inquiry progress.

Goals for the In-Service Series

To utilize in-service time most efficiently, specific activities were designed to reach identified goals. Goals for this series were as follows:

Goal Level	
I	Read the students' inquiry behavior.
II	Create the classroom conditions for inquiry.
III	Facilitate the students' growth as inquirers.
IV	Generate diagnostic data about the students' behavior.
V	Inquire into teaching.

An Illustrative In-Service Time Line

Goal Level	Activity	Time	
	Registration.	30 min.	Hour 0
V	Orientation and point of view; the need for change.	60 min.	Hour 1
V	Inquiry demonstration lesson with children.	45 min.	Hour 2
I	Small groups build definition of inquiry from demonstration lesson.	30 min.	
I	Groups share definitions.	15 min.	Hour 3
I, II	Small groups of participants experience inquiry as students revise and add to their definition of inquiry.	75 min.	Hour 4
V	Participants identify obstacles to teaching toward inquiry in their classrooms.		

Goal Level	Activity	Time	
I	Small groups classify inquirer behaviors using prepared written materials.[2]	30 min.	Hour 5
	Administrative details (directions, questions).	20 min.	
I	Groups of five participants listen to a prepared tape of an inquiry lesson and classify the inquirer behaviors.	60 min.	Hour 6
I,II	Mini-lecture: the conditions set of teacher behaviors.	15 min.	Hour 7
I,II	Small groups experience adult inquiry.	30 min.	
I,II	Groups of 15 participants analyze the previous adult inquiry activity to classify the teacher behaviors and relate them to the students' behavior.	60 min.	Hour 8
I,II	Groups of three participants use prepared materials designed to enable them to create a teacher behavior that will establish the conditions of inquiry in response to given inquirer operations.	60 min.	Hour 9 Hour 10
I,II	Homework: teach for inquiry using the conditions set of teacher behaviors. Bring a 10-minute tape of the lesson to the next meeting.	30 min.	Hour 11
I,II	Groups of 15 participants discuss their experiences in teaching toward inquiry.	30 min.	
I,V	Groups of 15 participants experience adult inquiry with attention to the strategies they use as inquirers.	30 min.	Hour 12
I,II	Groups of five participants analyze tape recordings of previous adult inquiry activity: coding teacher and inquirer behavior.	20 min.	

[2] Strasser, Ben. B. *Learning To Teach Toward Inquiry*. Hayward, Calif.: JS[2] Publishers. 1970.

Goal Level	Activity	Time	
I,II	Choice time: (a) review tapes, (b) individual review of practice coding, etc.	15 min.	Hour
III	Mini-lecture: the growth set of teacher behaviors.	15 min.	Hour
I,II,III	Groups of five participants listen to a tape recording of an inquiry activity and classify the inquirer and teacher behaviors. Teacher behaviors of the conditions and growth sets are demonstrated.	60 min.	Hour
I,II,III,V	Groups of five participants use prepared materials to create an appropriate teacher behavior in response to given student behaviors. The groups role-play the responses to test the effect of teacher behaviors on others.	45 min.	
III	Homework: Read about the growth set of teacher behaviors. Read about demonstration lessons participants will use in their classrooms.	20 min.	Hour 1
I,II,III,V	Groups of five participants take turns simulating the teacher's role in teaching toward inquiry.	120 min.	Hour 1
	The participants discuss the feelings they had as they implemented the role of teacher.		Hour 1
I,II,V	Choice time—leaders review tapes made by participants.	20 min.	Hour 1
I,II,III,V	Groups of 15 participants experience adult inquiry with more work on developing their abilities as inquirers.	30 min.	Hour 2
I,II	Large group reads about "getting ready to teach for inquiry," checks out materials.	30 min.	Hour 2
II,V	Large group listens to humorous tape about inquiry, "Reflections of a Hawg Caller."	15 min.	

Goal Level	Activity	Time	
I,II,V	Homework: teach for inquiry using the conditions and growth sets of teacher behaviors. Bring a 10-minute tape of the lesson to the next meeting.	20 min.	Hour 22
III,V	Large group mini-lecture: "Getting Better at It."	10 min.	
II,III,V	Inquiry demonstration lesson with students.	30 min.	Hour 23
I,II,III,V	Groups of 15 participants analyze the previous inquiry demonstration with students to identify inquirer and teacher behavior.	30 min.	Hour 24
IV	Mini-lecture: the diagnostic set of teacher behaviors.	15 min.	
V	Choice time—watch video tape of an inquiry lesson; review prepared materials on teacher errors; review participant tapes with consultants.	60 min.	Hour 25
V	Large group discusses obstacles in teaching toward inquiry that were identified in Hour 4 and notes those that remain at the conclusion of 26 hours of in-service training.	20 min.	Hour 26
V	Large group lectures on three teaching strategies and a model of inquiry.	45 min.	Hour 27
I,II,V	Choice time—small groups meet to experience inquiry in eight different subject areas.	45 min.	Hour 28
I,II,V	Repeat of choice time activities; participants change groups.	45 min.	
I,II,V	Small groups meet to critique choice activities.	45 min.	Hour 29
II,V	Individuals and mini-groups work together to build problem situations for inquiry in selected subject areas.	40 min.	Hour 30
	Evaluation of the series.	60 min.	Hour 31
	Announcement of optional follow-up meeting.		

About the Authors

The ideas represented in this book are evolving as the six authors function as an in-service team, developing and presenting teacher training programs in inquiry. The teacher and learner behaviors described herein form the base of instructional objectives for four- to ten-day workshops using a variety of instructional materials and strategies developed by the team. These workshops have been sponsored by the USDESEA (U.S. Dependent Schools, European Area) under the auspices of the University of Southern California, by the California Teachers Association, and by numerous school districts in the western United States.

The authors bring a variety of disciplinary backgrounds to their work as a team. Ben B. Strasser is a consultant with the Office of the Los Angeles County Superintendent of Schools. He is author of *Molecules in Motion,* which is presently in use as a California State Supplemental Science textbook, and has been author and coauthor of several articles on the topic of inquiry. Bob Babcock is regional consultant specializing in program planning for the Office of the Los Angeles County Superintendent of Schools. He served for many years as an elementary school administrator. Ray Cowan is an elementary school principal in the El Rancho Unified School District. He has contributed to the California State Framework for Social Science, as well as to general curriculum development and program evaluation. Gus Dalis is a health education consultant for the Office of the Los Angeles County Superintendent of Schools. He has written several articles for professional journals on health education and was coauthor of *Health Education, Theory and Practice* and of *Decisions: A School Health Education Program.* Stu Gothold, also an author of *Decisions: A Health Education Program,* is assistant superintendent of education for the South Whittier Elementary School District. Jim Rudolph is director of the Program Planning Task Force of the Office of the Los Angeles County Superintendent of Schools. He also teaches courses in multimedia and instructional technology at the University of Southern California.

In addition to their in-service work in teaching toward inquiry, the team is developing an instructional system entitled Toward Inquiry in Archaeology, which includes three television programs, filmstrips, pictures, other data bank materials, a teacher's guide, and a copy of this book. William R. Fielder, professor of education at Claremont Graduate School, and Jane Gothold, archaeologist and wife of one of the authors, have also been working on the development of this unit of study.

The archaeology project, as well as the publication of this book in its earlier form (*Inquiry*), were made possible through the leadership of Richard M. Clowes, Los Angeles County superintendent of schools; Maylon E. Drake, assistant superintendent of educational programs and services; and Grant E. Thayer, director of the Division of Curriculum and Instructional Services.

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